



ZHUHAI FLYERS
HIGHLIGHTS FROM
CHINA'S BIGGEST
AIR SHOW EVER
REPORT P28

UAV MOTHERSHIPS
DARPA concept envisages
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deployed from aircraft
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ROYAL QUARTET
World's number one
Boeing Business Jet
operator adds two BBJs,
two Global 5000s **37**

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IN-SERVICE REPORT

DREAMLINER: THE VERDICT

What 787-8 operators really think of it

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COVER IMAGE

All Nippon Airways' 787-8 JA805A is pictured visiting Beijing in January 2012, three months after the type entered revenue service with the carrier **P38**



BEHIND THE HEADLINES

Our crack reporting team was out in force at **Airshow China** in **Zhuhai**, where Beijing lifted the veil on several of its new military aircraft and advanced domestic airliner projects (P28). Jetting in were **Greg Waldron**, **Mavis Toh**, **Mark Pilling** and **Aaron Chong**



NEXT WEEK MADE IN IRAN

The licence-built IrAn-140 and the birth and death of Iran's aerospace ambitions. Plus: military simulators census

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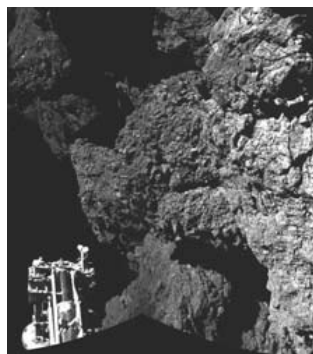
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Successful soft landing on comet Churyumov-Gerasimenko **P12**. AI Fursan display team at Airshow China **P35**



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CAE offers training centres, training services, and simulation products for helicopters.

IMAGE OF THE WEEK

Airbus has delivered a first trio of CFM International CFM56-powered A320s to Indonesia's Lion Group, for operation by Batik Air. Accepted at the company's Toulouse site, the 156-seat aircraft are drawn from a major order totalling 60 current-model A320s, 109 A320neos and 65 A321neos

View more great aviation shots online and in our weekly tablet edition:



Airbus

THE WEEK IN NUMBERS

255%

Elbit Systems

The increase in Elbit Systems' third quarter interest bill, from \$6.6m to \$23.4m, as the Israeli shekel lost strength

\$10_{bn}

Moody's Investor service

Moody's F-16 upgrade market valuation. BAE Systems could fail to benefit after South Korean cancellation, it says

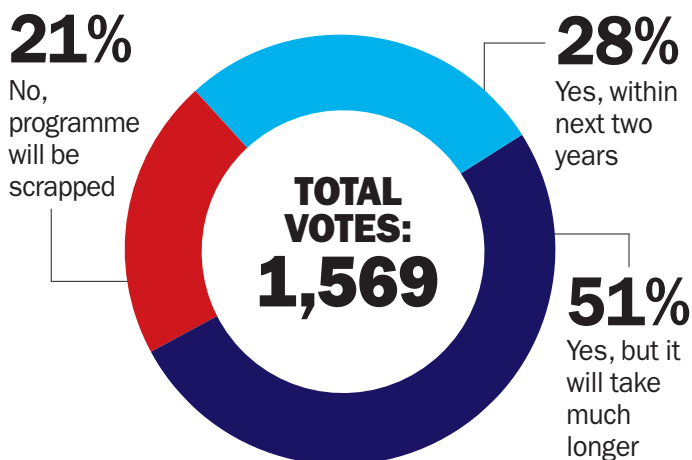
25,000

Flightglobal dashboard

The number of spare parts from 3,000 suppliers available to ATR operators via a three-year deal with B/E Aerospace

QUESTION OF THE WEEK

Last week, we asked: **Will Virgin Galactic recover to take paying passengers into space?** You said:



This week, we ask: **787 entry-into-service problems**

- ☐ All in the past
- ☐ More minor niggles likely
- ☐ Still some big concerns

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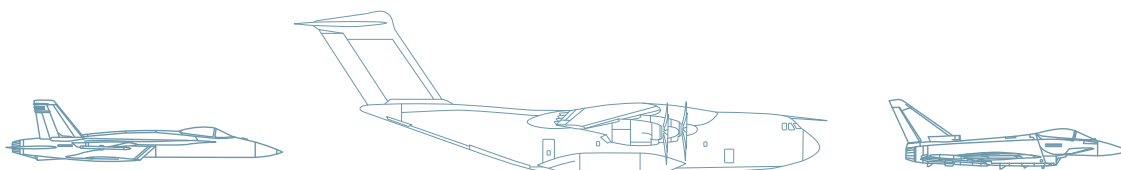
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Growing up in public

In the Internet age, no shortcoming in an airliner's development programme goes unnoticed. Boeing has tackled many early issues with the 787-8, but still must address other challenges

Developing a new commercial aircraft is hard, and the process of introducing it to commercial service can be humbling. Like all major aircraft manufacturers, Boeing seems to become reacquainted with this costly lesson once every decade or so.

But there is something altogether different about the spectacle of Boeing's entry into service for the 787-8.

The introductions of the 747 and 777 are both fondly remembered by nostalgia buffs, but in reality were wrenching experiences for all involved. The difference between then and now is that the "teething" issues that bedeviled early operators of these previous types were mostly hidden from public view.

The 787 is responsible for many aviation industry firsts, but one of the most under-appreciated debuts of the Dreamliner was its coming of age at the dawn of a revolution in social media.

One of the Dreamliner's firsts was its coming of age during a revolution in social media

A modern commercial aircraft is a highly complex instrument operating in an extreme environment. The flight test phase is intended to prove that it is safe and airworthy – not to weed out every potential operational glitch that has no bearing on safety at an aircraft level. As such, it is no surprise that some systems need more time to mature than others.

For the 787, however, the level of public scrutiny drifted at times into the realm of the absurd. Some normally reliable mainstream media outlets even accused Boeing of intentionally sacrificing safety to boost sales.



The 787's every move has been scrutinised

Boeing can be blamed for having at first installed an inherently unsafe battery design in the 787, which also slipped past the notice of a regulatory community still ill-informed on the hazards of lithium-ion power. But the company paid for this error – which was not some diabolical plot – in spades.

Leaving battery issues aside, the fuel efficiency of the 787-8 is nearly universally appreciated by operators so far, while the reliability of certain systems continues to cause nearly universal dissatisfaction. It is clear that Boeing first misjudged how mature the flight control systems were at entry into service, and then how long it would take to raise the aircraft's advanced electrical systems to acceptable reliability levels.

Despite those misjudgments, the 787 has seen its backlog increase since service entry, although Boeing's ability to make a profit on it is another story.

A new Airbus widebody is poised to be delivered to its first customer in a few weeks. The A350 will no doubt also attract scrutiny over every cancelled flight. ■

See This Week P13, In-Service Report P38

Enter the Dragon

Guests at a Comac banquet during Airshow China in Zhuhai were treated to a video of Chinese premier Li touring the C919 factory and exhorting the production team to greatness.

The message is clear: China will only truly arrive on the world stage when its aircraft equal, or surpass, those produced in Europe and the USA. It is Beijing's patriotic mission to become a world-class aerospace power; nothing else will do.

There were far more air force officers in evidence at the show than in previous years, and additional halls had been added. Large banners of the Shenyang J-31 fighter graced several buildings, and AVIC was able to announce first orders for its MA700 turboprop.

Engines remain a weakness, and China has struggled in other areas such as flight control software and certification. But although it has yet to produce a world-class airliner, China is already having a profound effect on the industry. Nearly one-quarter of the aircraft delivered every month go to the nation, which is also getting ever more workshare on Western types, and attracting joint ventures with European and US firms.

The ripples China is making will eventually become a strong and irresistible current – and then, some future day, a Western airline will place a large order for a Chinese-produced airliner. The era of the duopoly will be over, and the triumvirate will be born. ■

See Show Report P28



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Alan Newby, Chief Engineer Future Programmes and Technology – Aerospace



Rolls-Royce



BRIEFING

FLIGHT-TEST 787 BECOMES MUSEUM PIECE

HERITAGE Boeing on 8 November donated one of its original flight test 787-8s to the Museum of Flight in Seattle. Rolls-Royce Trent 1000-engined MSN ZA003 was used extensively during the Dreamliner's interior certification programme, and circumnavigated the globe several times during the "Dream Tour" in 2011 and 2012. The airframer plans to donate two more 787s used in its flight test programme to other museums around the world.

See In-service report, P38

IRANIAN RQ-170 GETS AIRBORNE

DEBUT Iran says it has conducted a successful first flight with a stealthy unmanned air vehicle reverse-engineered from the US Air Force Lockheed Martin RQ-170 Sentinel it captured in December 2011. Tehran claims that an army electronic warfare unit downed the US surveillance asset while it was being flown over Kashmar, roughly 120nm (222km) from its border with Afghanistan.

BONO'S LEARJET LOSES REAR DOOR IN FLIGHT

INCIDENT German investigators still have not found what they are looking for – an answer to how a Bombardier Learjet 60, owned by U2 frontman Bono, lost its rear door along with the luggage in the cargo hold, as it was making its descent into Berlin Schönefeld airport. The incident happened on 12 November, en route from Dublin. The Irish rock star was on board the midsize business jet – registration D-CGEO – when the incident happened. Nobody was hurt.

DUTCH F-35 TEST SQUADRON ESTABLISHED

ORGANISATION The Royal Netherlands Air Force has re-established its 323 Sqn at Eglin AFB in Florida, with the aim of supporting the initial operational test and evaluation of Lockheed Martin's F-35 Lightning II after relocating to Edwards AFB, California, late this year. Three Dutch pilots have qualified to fly the conventional take-off and landing F-35A, which will become operational with the nation in 2019.

BOSNIA TAKES CONTROL OF ITS AIRSPACE

OPERATIONS Bosnia's air navigation services authority BHANSA has started formally taking control of the airspace over the Balkan state. The authority has commenced air traffic control operations within the Sarajevo flight information region initially up to 32,500ft. En route traffic above that level will be managed, for the time being, by Serbian and Croatian centres in Belgrade and Zagreb.

AVIANCA EYES 'HUNDREDS' OF NEW NARROWBODIES

FLEETS Latin American airline group Avianca plans to place an order for "hundreds" of new narrowbodies and is studying the Boeing 737 Max and Airbus A320neo families. The airline wants to use the aircraft for both growth and replacement, chief executive Fabio Villegas said at the ALTA Airline Leaders Forum in Nassau, the Bahamas. Avianca operates 94 A320-family aircraft, and Villegas says it will require new deliveries from 2019 onwards.

SOUTH KOREA STEPS CLOSER TO MOON MISSION

SPACEFLIGHT A South Korean bid to send an unmanned mission to the Moon in 2020 last week passed Seoul's strategy and finance ministry's feasibility study, the last stage before budget setting. According to the newspaper *Business Korea*, the plan, first mooted in 2007 and calling for an orbiter, lander and launch by the Korea Space Launch Vehicle, has been accelerated by the government.

The ESA lander came to rest after rebounding twice off the rocky surface



Rex Features

EXPLORATION DAN THISDELL LONDON

Philae set to tap comet's secrets

Landing of probe on 67P/Churyumov-Gerasimenko latest feat in Rosetta quest to study origins of the Solar System

The European Space Agency says the first-ever soft landing on a comet was a success, despite having seen its robotic lander Philae come to rest on the steep rim of a crater on the surface of 67P/Churyumov-Gerasimenko.

Touchdown occurred on 12 November, after a 7h, 22.5km unguided descent from Philae's parent ship, Rosetta, which is orbiting the comet some 510 million km from Earth.

About the size of a domestic washing machine and with three legs, the lander rebounded twice off the surface. The first contact pushed it back up to 3,280ft, and it was 2h before it touched down again. It then took another 38min to come to rest. A harpoon-style anchor mechanism did not fire on touchdown as expected, the ESA team found.

Philae quickly returned its first images from the surface, but as of 13 November teams at mission control in Darmstadt and at the dedicated Rosetta mission lander control centre in Cologne had not activated its mechanical systems to begin scientific research, for fear of upsetting its balance.

Roughly 4km across and with very little gravity, the comet has a highly irregular shape and a surface strewn with boulders, craters and other obstacles.

"Rosetta is trying to answer the very big questions about the

history of our Solar System. What were the conditions like at its infancy, and how did it evolve? What role did comets play in this evolution? How do comets work?" says Matt Taylor, ESA Rosetta project scientist.

Philae's primary science mission includes recording a full panoramic view of the landing site, including a section in 3D, high-resolution images of the surface immediately underneath it, plus on-the-spot analysis of the composition of the comet's surface materials, after deploying a drill that will take samples from a depth of 23cm and feed them to an onboard laboratory for analysis. Its detailed surface measurements will complement and calibrate the extensive remote observations already made by the Rosetta orbiter.

An extended science phase using the lander's rechargeable secondary battery may also be possible, if the Sun's illumination conditions allow and dust settling on the solar panels does not prevent it. This activity could potentially run until March 2015, after which time conditions inside the lander are expected to be too hot for it to continue operating.

Rosetta was launched on 2 March 2004 and travelled 6.4 billion km through the Solar System before arriving at the comet on 6 August 2014. ■



SpaceShipTwo pilot
recalls moments
before break-up
THIS WEEK P14

THIS WEEK

RETROFITTING STEPHEN TRIMBLE WASHINGTON DC

Boeing delivers design fix for APU 'bowing' on 787-8

"Nuisance" procedure scrapped as airframer rolls out modified Pratt & Whitney turbine

Boeing has rolled out a permanent fix for a design problem in the 787-8's auxiliary power unit (APU) that flight test crews identified more than three years ago.

A new APU design has recently entered service that prevents the shaft from "bowing" under certain conditions and requiring replacement, Boeing says.

Some of the 787-8's earliest operators have started receiving the new Pratt & Whitney APS5000 units, confirms Japan Airlines airplane performance group director Eisuke Hama. "In early September, all the APUs were changed or replaced with an improved one," Hama says.

The APS5000 – a single-shaft, variable speed gas turbine – serves a crucial role in the 787's electrical system. On the ground, the APU is used to power the variable frequency starter generators, which in turn start the engines. In-flight, it can supply back-up power if the four engine-mounted electric generators fail at the same time.

During a flight test, however, Boeing detected a design flaw



Japan Airlines updated its fleet's power units in September

with the system. After the APU is shut down, if the inlet door to the tail-mounted APU is closed, hot air could be trapped inside the unit.

Over time, the extra heat could cause a shaft imbalance, or "bowing". The imbalance would later potentially prevent the APU from starting, leading to a condition called a "bowed rotor hung start".

"We caught the bowed rotor issue on our flight line because we were doing successive starts that would not be typical in an airline operation," says Mike Fleming, Boeing's vice-president for 787 support and services.

To prevent a bowed rotor incident, Boeing developed a procedure that proved unpopular with 787 flightcrew. It required them to leave the APU door open for at least 40min after it is shut down. Since the APU is usually turned off as the 787 is leaving the gate, the 40min would often expire during a high workload time of flight, as the aircraft ascends to cruising altitude through multiple air traffic control systems.

"This is a nuisance," says Yohannes Hailemariam, Ethiopian Airlines' chief pilot. "Sometimes we forget [to close the door]." ■

See In-service report P38

REGULATION

Canada eases restrictions on lightweight UAVs

Canada has lifted most airspace restrictions on unmanned air vehicles weighing less than 2kg (4lb), and under many certain circumstances for those totalling up to 25kg.

In Canada, UAV operators had been required to file requests for a special flight operations certificate (SFOC) at least 20 working days before a flight. The process began to overwhelm Transport Canada's agents – on 30 October, the Canadian aircraft owners and pilots association noted that requests for UAV-based SFOCs had increased from 66 in 2010 to 914 already this year.

As a result, Transport Canada has issued an exemption for vehicles of below 2kg, meaning operators will now only be required to notify the agency of a planned operation and stay below 300ft above ground level, within line of sight of the pilot and at least 5nm (9km) away from an airport. Between 2kg and 25kg, operators must comply with an expanded set of 30 conditions or file a request for a SFOC. ■



Read more analysis of the unmanned air system sector:
flightglobal.com/UAV

DEVELOPMENT STEPHEN TRIMBLE WASHINGTON DC

Service entry looms as FAA certifies A350-900

Airbus has received type certification for its A350-900 from the US Federal Aviation Administration, as the new wide-body moves closer to entry into service next month. Announced on 12 November, the milestone follows type certification from EASA on 30 September.

A first A350-900 is planned for delivery to launch customer Qatar Airways between 8 and 10 December.

LATAM's TAM Airlines is expecting to receive its first A350-900 in 2015, followed by the first delivery to Synergy

Group's Avianca in 2016. The two US carriers that have ordered versions of the aircraft – American Airlines and United Airlines – are not scheduled to receive their first examples until 2017.

Announcement of type certification by the FAA comes as Delta Air Lines also evaluates the A350-900. The Atlanta-based SkyTeam carrier is also considering the Boeing 787-9, with a decision expected by the end of this year.

Airbus has amassed more than 700 orders for the A350-900 so far. ■



Delta Air Lines is weighing up the type, alongside the competing 787-9



BUDGET DAN PARSONS
WASHINGTON DC

Obama seeks more funding for Inherent Resolve

US President Barack Obama has requested an additional \$5.6 billion from Congress to support the fight against Islamic State insurgents in Iraq and Syria, including \$55 million to acquire more small tactical unmanned air vehicles.

The 10 November request for amendments to Obama's fiscal year 2015 budget plan also lists \$544 million for "classified purposes" for the US Air Force.

The request also lists \$544 million for "classified purposes" for the US Air Force

The additional funding is aimed at "sustaining personnel forward-deployed to the Middle East to provide training and assistance to partner security forces" during Operation Inherent Resolve, says Obama's letter to Congress. The funding will also provide "intelligence, surveillance and reconnaissance platforms and support".

Potential candidates for the tactical UAV requirement could include the Boeing Insitu Scan Eagle and RQ-21 Blackjack. Their limited range means that in Iraq and Syria, the aircraft could be operated by personnel at one of two staging bases the Obama administration has announced are to be built outside Baghdad and in Anbar province.

A combined \$78 million has been requested to buy more Lockheed Martin AGM-114 Hellfire and Raytheon AGM-65 Maverick air-to-surface missiles and Boeing GBU-39 bombs, plus Raytheon BGM-109 Tomahawk cruise missiles.

If approved, the additional sum would boost spending for the year via Washington's overseas contingency operations funding mechanism to \$63.6 billion. ■

INVESTIGATION STEPHEN TRIMBLE WASHINGTON DC

SpaceShipTwo pilot recalls moments before break-up

Tail feather rotation should have occurred only as Virgin Galactic aircraft passed Mach 1.4

The surviving pilot of the SpaceShipTwo crash on 31 October has told investigators he was unaware the co-pilot had unlocked a system that rotates the tail feathers of the vehicle moments before its in-flight break-up, the US National Transportation Safety Board (NTSB) says.

NTSB investigators have focused on video and telemetry showing that co-pilot Mike Alsbury prematurely unlocked the tail feather rotation system as SpaceShipTwo accelerated through Mach 1. The test card on his knee stated that the tail feathers should not be unlocked until SpaceShipTwo's speed had reached at least M1.4. Alsbury was killed when the Virgin Galactic aircraft broke apart at 55,000ft.

Pete Siebold told investigators he survived when his seat was ejected by the in-flight break-up. He then "unbuckled from his seat at some point before the parachute deployed automatically",



Co-pilot Mike Alsbury died in the incident at 55,000ft

the NTSB says. The agency has completed on-scene investigations of the crash site in California's Mojave Desert, and the recovered wreckage of SpaceShipTwo is now stored in a secure location.

As SpaceShipTwo was performing a flight test, the break-up was observed by telemetry gathering more than 1,000 parameters per second, and by cameras inside SpaceShipTwo, its mothership WhiteKnightTwo and on the ground.

A group of NTSB investigators will assemble this week at the board's recorders laboratory to evaluate the video footage.

Meanwhile, Virgin Galactic has vowed to complete assembly and begin flight testing of the second SpaceShipTwo vehicle by April. The space tourism company, which collaborated with Scaled Composites to develop the design, has acknowledged about 24 of more than 700 deposit holders of suborbital launch tickets have requested refunds. ■

ROTORCRAFT DOMINIC PERRY LONDON

Bell 505 passes first flight milestone

Bell Helicopter has performed the first flight of its newest model, the 505 Jet Ranger X, from its facility in Mirabel, Canada.

The aircraft was airborne for around 30min with a top speed of 60kt (111km/h) and made two laps in a local traffic pattern, as

well as assessing low-speed controllability.

Launched at the 2012 Paris air show, initially as the "short light single", the helicopter has made rapid development progress, culminating in the maiden sortie. The pace of development has

been aided by the use of in-service parts – principally the main rotor and dynamic components from the 206L4.

The new model also features a FADEC-equipped 504shp (371kW) Turbomeca Arrius 2R turboshaft engine and Garmin's G1000H avionics suite.

Destined to take on the market currently dominated by the Robinson Helicopter R66, the 505 is priced at around \$1 million. It has so far accumulated more than 240 letters of intent from customers, including a new agreement with China's Reignwood Investment. Certification and entry into service are anticipated in late 2015. ■

See Show Report P33



The Jet Ranger X was aloft for around 30min

“

“Boeing has pushed the design envelope
on this aircraft and it shows.

It is widely accepted by airlines and investors alike.”

”

Martin Olson
Head of OEM Relations
AerCap



THE DREAMLINER EFFECT.
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AERODYNAMICS DAN THISELL LONDON

Morphing wings begin to take shape

NASA starts testing seamlessly bending assembly that can mimic bird movement with first flight of adapted Gulfstream III

NASA has kicked off a flight test campaign to evaluate wing surfaces that can change shape in-flight.

The Adaptive Compliant Trailing Edge (ACTE) joint effort between NASA and the US Air Force Research Laboratory (AFRL) hopes to bring about the day when rigid control surfaces can be replaced by smoothly morphing surfaces, which would more closely mimic bird flight and promise to make future airliners quieter and more fuel efficient.

Researchers at the Armstrong Flight Research Center in Edwards, California, replaced a Gulfstream III's conventional aluminium flaps with advanced, shape-changing assemblies that form seamless bendable and



The specially-designed flaps were locked at a specified setting to gather data

twistable surfaces. Flight testing will determine whether flexible trailing-edge wing flaps can improve aerodynamic efficiency and reduce noise generated during take-offs and landings.

The flaps, designed and built by FlexSys of Ann Arbor, Michigan, were locked at a specified

setting during the initial ACTE flight, but different flap settings will be employed on subsequent flights to collect a variety of data demonstrating the capability of the flexible wings to withstand a real flight environment.

AFRL programme manager Pete Flick says the flaps have the potential to be retrofitted to existing aircraft wings or integrated into new airframes. "We have matured the concept to a final demonstration that should prove to the aerospace industry that this technology is ready to dramatically improve aircraft efficiency," he says.

Thomas Rigney, ACTE project manager at Armstrong, says the first flight went as planned. "We validated many key elements of the experimental trailing edges," he says. "We expect this technology to make future aircraft lighter and quieter. It also has the potential to save hundreds of millions of dollars annually in fuel costs."

NASA says ACTE's advanced lightweight materials could reduce wing structural weight and give engineers the ability to aerodynamically tailor wings to promote improved fuel economy and efficiency, reducing environmental impact. ■



Flexible trailing-edge technology could offer greater efficiency

LAUNCH STEPHEN TRIMBLE WASHINGTON DC

New Mooney rises with Chinese-inspired designs

Mooney International is back in the aircraft development business, unveiling two new diesel and jet fuel-powered models at Airshow China in Zhuhai.

Focused on the slowly-emerging Chinese training and privately-owned aviation market, the composite-skinned Mooney 10T and 10J models move the company's recently restarted production line away from avgas-driven engines and solely metallic structures. The new models also provide stepping stones to the larger M20 types – the Acclaim Type S and Ovation3, it says.

"The M20J helped change general aviation by making flying practical for more people across the USA. Now, the M10J promis-

es to do the same for the world," says Mooney International chief executive Jerry Chen.

Mooney halted production at its factory in Kerrville, Texas, in 2009 after an 80-year run. After a five-year hiatus, a Chinese investment group acquired the company and restarted production. As of July, a Florida-based distributor had placed orders for three new M20 models, while deals for another 10 of the aircraft have been secured with buyers in China.

Production of the M20 resumed with plans to ramp up to one delivery per month by the end of this year, two per month next year and more as demand evolves. The next step is to bring the new aircraft to the market, with certifica-

tion and deliveries in 2017. Mooney has not identified the initial certification agency for the M10 series, but notes the US Federal Aviation Administration currently certifies the M20 series.

The M10T, with a Continental CD-135 diesel engine, will serve as a trainer in the Mooney portfolio. The CD-155 diesel-powered

M10J, meanwhile, will offer private owners an aircraft with a 170kt (315km/h) indicated air speed, 1,000nm (1,850km) range and a "competitive price".

"These aircraft show great product innovation coupled with Mooney's long line of history-making aircraft," says Chen. ■

See Show Report P28



The M10T is intended as a trainer for the company's portfolio

“

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CEO
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TESTS DAVID KAMINSKI-MORROW
LONDON

Reduced-thrust take-off cleared for Superjet 100

Sukhoi's Superjet 100 has secured approval from Russian authorities to conduct take-off at reduced thrust.

The enhanced certification allows the lower thrust to be used during departures from runways longer than 2,000m (6,560ft).

Sukhoi has been extending the capabilities of the type since its initial certification by the Interstate Aviation Committee in January 2011.

The airframer performed 22 flights at Moscow's Zhukovsky test centre with one of the flight-test aircraft, number 95003, to explore various thrust settings for its PowerJet SaM146 engines.

Using the reduced thrust setting will lower engine load and turbine temperatures, says Sukhoi's civil aircraft division, adding: "This, in turn, minimises aircraft maintenance cost." ■

FLEET JON HEMMERDINGER
WASHINGTON DC

ATRs to replace ageing Q300s at Bahamasair

Bahamasair is seeking to acquire five new ATR turboprops by the end of 2015, to replace its elderly fleet of Bombardier Q300s.

The new aircraft could comprise a mix of three 50-seat ATR 42s and two 70-seat ATR 72s, the airline's managing director Henry Woods told *Flight International* in Nassau, where Bahamasair is based and the ALTA Airline Leaders Forum was held.

Although the deal has not been finalised, Woods says the airline plans to divest all five of its Q300s as it acquires the new ATRs. The Q300s were placed in service between 1989 and 1992, and have accumulated between 47,000 and 67,000 cycles, Flightglobal's Ascend Fleets database shows. ■



The carrier is planning aircraft with a higher capacity than its Fokker 100 fleet

FLEET MICHAEL GUBISCH LONDON

Austrian looks set to swap its old Fokkers for CSeries

Lufthansa subsidiary's controversial new aircrew contract refers to Bombardier twinjet

Austrian Airlines is being tipped to place an order for Bombardier's CSeries to replace its ageing Fokker regional jet fleet after it emerged its newly-linked labour deal references the type.

Local media have reported that the wholly-owned Lufthansa subsidiary's new labour agreement for pilots and flight attendants covers terms for the deployment of CSeries aircraft. It does not mention alternative models, such as Embraer's E-Jet family.

Austrian says that the labour agreement – which is to become effective in December – has been based on the CSeries as it represents a potential future scenario for the carrier in terms of aircraft and fleet size.

However, the carrier insists that no decision has yet been made about the aircraft type that will be acquired to replace the existing Fokker fleet.

That decision is to be made by Austrian's management and its parent group in 2015.

Austrian is planning to introduce aircraft with higher capacity than its 100-seat Fokker 100, and to operate the new type as part of its mainline instead of regional fleet. But the plan has caused re-

sentment among pilots.

While the airline will maintain two separate cockpit workforces for the mainline and regional aircraft under the new labour deal, it is planning to employ pilots from both corps on the future type.

The labour contract has been agreed by management and staff representatives in October. But the airline's works council and union have said that details of the framework need to be "further developed and extended" in terms of its "social components" from 2015 onward.

Flightglobal's Ascend Fleets database shows Austrian has 15 Fok-

The carrier insists no decision has yet been made on the aircraft that is to replace the existing Fokker fleet

ker 100 and seven Fokker 70 regional jets. The airline is planning to replace the twinjets by 2018.

Sister Lufthansa Group carrier Swiss International Air Lines has ordered 30 CSeries aircraft for its regional fleet, with deliveries scheduled to begin in the second half of 2015. ■

TECHNOLOGY MICHAEL GUBISCH LONDON

Full e-cockpit revolution in 15 years

Austrian Airlines is introducing tablet-based electronic flightbags.

The Lufthansa Group subsidiary has selected a Microsoft Windows-based system with Surface Pro 3 tablet computers, which will be employed across the airline's fleet.

Equipment holders are to be gradually installed in the fleet's cockpits. This will allow Austrian's pilots for the first time to use their EFBs in all flight phases, including critical stages such as take-offs, landings and

periods of turbulence, the airline says. Pilots will be able to download flight documents and update other information on the ground, but the tablets will be offline in flight.

Austrian says that while it became the first European airline to supply pilots with electronic flight documents in 1999, it is only now able to offer its cockpit crew members a full replacement of conventional paper-based flight documents through the new system. ■



IAG trimming fat
from fleet of A320s
AIR TRANSPORT P20

INCIDENT JON HEMMERDINGER WASHINGTON DC

Prop pierced Q400 fuselage

Blade bursts through Air Canada Jazz turboprop's hull on emergency landing at Edmonton

A photograph released by the Transportation Safety Board (TSB) of Canada shows that a propeller blade pierced the fuselage of an Air Canada Jazz aircraft that made an emergency landing at Edmonton International airport earlier this month.

The image, which shows that a blade punched through a passenger window adjacent to the Bombardier Dash 8 Q400's right side turboprop, suggests that the accident may have been more serious than initially reported.

Images also show that all of the blades on the engine's propeller broke free from the propeller hub. The aircraft, with the registration C-GGBF, was being operated as Air Canada Express flight 8481 on



There were "no severe injuries" to the passengers and crew

6 November from Calgary to Grande Prairie.

One of the aircraft's tyres burst during take-off from Calgary, which led the crew to make an emergency landing in Edmonton at about 20:30 local time, according to reports and the airline.

During landing, the Q400's gear collapsed and a propeller blade tore through the cabin, hit-

ting one passenger in the head, according to reports. Despite the serious nature of the incident, Jazz says there were "no severe injuries" to the 71 passengers and four crew aboard the aircraft.

Bombardier says the incident raises a "number of questions", adding that it is "indeed unusual" for a propeller to pierce the passenger cabin. ■

INVESTIGATION

Indian authority probes SpiceJet buffalo-collision

The Airports Authority of India (AAI) is conducting an investigation into an incident in which a SpiceJet Boeing 737-800 hit a buffalo during its take-off roll on 6 November.

The accident took place at 19:06 local time, as the aircraft was operating flight SG622 between Surat and New Delhi, says India's Ministry of Civil Aviation.

"Timely action by the pilot of the aircraft averted a mishap and the aircraft was brought back to the apron for checks," the ministry adds.

Images on social media show that the left engine's nacelle sustained serious damage. However, no passengers were injured. ■

APPROVAL MAX KINGSLEY-JONES LONDON

Flag carrier hopeful for UK-Qatar open skies pact

Qatar Airways is optimistic that Qatar and the UK will soon reach an open skies agreement, after filing documentation with the UK Civil Aviation Authority for a financial audit of the airline.

"The British CAA in the last bilateral [negotiations] demanded a lot of information, clarifications and documentation from us, which we provided to them," says Akbar Al Baker, chief executive of

state-owned Qatar. "Now they are convinced that Qatar is not subsidised – as is the perception that has been created in the EU by individuals that have been signing letters to the Commission – and Qatar will hopefully soon receive open-skies access to the UK."

The Oneworld member has been exploring a commercial partnership with fellow member British Airways on Doha-London services. ■



Qatar Airways not subsidised, says CEO Al Baker

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RATIONALISATION DAVID KAMINSKI-MORROW LONDON

IAG aims to standardise on its A320s

Group strategist details how three airlines will begin single-sourcing on suppliers across short-haul fleet to save costs

IAG has detailed its efforts to cut costs by harmonising aircraft configurations across the short-haul fleets of its three operators.

British Airways, Iberia and Vueling have some 260 Airbus A320s between them, including the fleet of Iberia Express, spread across more than 25 bases.

But IAG head of group strategy Geoffrey Weston, speaking during an investor briefing, said a mix of specifications leads to higher expenditure.

Weston says Airbus offers around 400 choices across 250 categories for cabin configuration, avionics and emergency equipment.

He says the three carriers have

sourced cockpit windows from three suppliers, pointing out that there is a 30kg difference between the lightest and heaviest – representing a potential €2,800 (\$3,500) saving in annual fuel burn per aircraft.

Two operating companies had a second cockpit jump-seat, weighing 12kg. These have been removed, cutting the cost of the seats, as well as maintenance.

Removed items cut 80-120kg from the aircraft's weight, while another 100-380kg saving can be achieved by switching to lighter seats. Overall weight reduction can reach 220-470kg, says Weston, saving €20,000-45,000 in fuel burned annually by each aircraft.

Iberia and its siblings will save fuel with lighter jets



He puts the overall cost-saving per aircraft from harmonisation at €500,000 to €1 million, with 40% sourced from avionics and systems changes and another 30% from revised cabin definition. Group joint-procurement savings

account for the other 30%.

BA, Iberia and the low-cost operators are also shifting to higher-density seating arrangements. "In a world of dedicated aircraft it's hard to move things around," says Weston. ■

FLEET DAVID KAMINSKI-MORROW LONDON

BA accelerates retirement of 767s to make way for arrivals

British Airways is to quicken the retirement of its Boeing 767s and has advanced slightly the delivery schedule of its Airbus A380 and Boeing 787 fleets.

The airline aims to have only four 767s in its long-haul fleet by the end of 2015, compared with seven

previously.

Parent company IAG says that all the long-haul 767s will be retired by 2016. They will be replaced by 787s.

In a fleet schedule disclosed during an investor briefing, IAG shows that BA has slightly accelerated the 787 delivery schedule and will have

13 by the end of next year.

BA is to start introducing 787-9s in 2015 and will begin receiving A350s in 2018 and 787-10s the following year.

The carrier has also brought forward an A380 delivery from the first quarter of 2016 to the fourth quar-

ter of 2015, by which point it will have 10 of the type with two outstanding.

BA has a batch of 767s in its short-haul operation which will be retired by 2018, replaced with A320-family jets. The carrier will also remove its 737s by 2015. ■



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The 1900D has the highest cost per seat to operate

Airimages

STRATEGY FIRDAUS HASHIM SINGAPORE

ANZ to drop 1900Ds in regional network revamp

Air New Zealand is to cut some of its regional routes and dispose of its 19-seat Beechcraft 1900Ds while adding larger turboprops to its fleet, following a comprehensive review of its regional network.

The carrier says it will progressively restructure its network around 50-seat Bombardier Dash 8 Q300s and 68-seat ATR 72s operated by subsidiaries Air Nelson and Mount Cook Airline.

It will also take delivery of four more ATR 72-600s over the next four years, while the 17 1900Ds operated by Eagle Airways are to be phased out by August 2016.

"The 19-seat aircraft is the smallest in the Air New Zealand

fleet, but has the highest cost per seat to operate because the fixed costs of operation are distributed across fewer passengers," says the carrier's chief executive Christopher Luxon. He adds that over the past two years, Eagle Airways has lost NZ\$1 million (\$786,000) per month from operating the 1900Ds.

The announcement has raised doubt over Eagle's future, and Luxon says the airline will, with the unit's management, staff and unions, "begin a process of determining the future of the business".

Flightglobal's Ascend Fleets database shows that Air New Zealand's three regional carriers operate a total of 56 turboprops. ■



Boeing

ORDER

Lessor SMBC opts for 80 Max 8s

SMBC Aviation Capital has ordered 80 Boeing 737 Max 8s – the largest single order for the re-engined variant from a leasing company. SMBC also becomes the 50th customer for the 737 Max, and takes the programme's total orderbook to more than 2,400 aircraft. Flightglobal's Ascend Fleets database shows that, prior to the latest order, six lessors had ordered a total of 371 737 Max twinjets. Ascend also shows that SMBC has a total of 389 aircraft in its portfolio and a further 140 on order, including 14 737-800s and 110 Airbus A320neos.

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Pilatus waits on
Indian PC-7
decision
DEFENCE P24

INVESTIGATION DAVID KAMINSKI-MORROW LONDON

Putin blames MH17 crash site obstruction on Ukraine

Accusations of separatists denying access “absolutely ungrounded”, insists president

Russian president Vladimir Putin has rejected the suggestion that access to the Malaysia Airlines flight MH17 crash site is being obstructed by separatists.

Putin made the remarks during an Asia-Pacific summit in Beijing, as he met with Malaysian prime minister Najib Razak.

References to the territory around the Boeing 777 crash site being controlled by pro-Russian separatists are “absolutely ungrounded”, he insists.

Putin says the “opposing party” is “constantly bombarding” the area, preventing investigative work.

He says both the Russian and Malaysian governments are demanding a “complete” and “objective” international investigation into the 17 July loss of MH17 over eastern Ukraine.

Razak notes that the preliminary investigative assessment indicated the crash was “not a random incident”, but that the aircraft had been brought down by multiple high-energy impacts. He says the inquiry has “more



The Malaysia Airlines Boeing 777-200ER crashed on 17 July

questions than answers”, and additional work needs to be carried out to determine the nature of the objects involved and their source.

“To do this we need to obtain full access to the site where the crash occurred, so that we can analyse the wreckage,” says Razak, adding that traces of the objects were likely to remain in

the fuselage and other sections of the 777.

“We hope that both sides will ensure free and full access to the crash site. Unfortunately this has not happened,” he adds.

Putin says observance of a complete ceasefire is necessary for the inquiry to proceed, and also to stabilise the situation in Ukraine. ■

EFFICIENCY
GREG WALDRON SINGAPORE

SIA fuel usage down 3% after A340 retirement

Singapore Airlines Group consumed about 3% less fuel volume in its 2014-2015 fiscal first half, mainly due to its termination of a Singapore-Newark direct routing in November 2013.

In a results briefing, SIA executives say the vast majority of the reduced fuel volume came through the cessation of the

SIA took delivery of its five A340s in late 2003 and early 2004

ultra-long-haul route, which it had operated with Airbus A340-500s equipped with just 100 business-class seats.

Flightglobal's Ascend Fleets database shows that SIA took delivery of its five A340s in late 2003 and early 2004.

The aircraft were returned to Airbus after being retired from SIA's fleet.

Ascend shows three of the aircraft remain parked, while one was sold to Las Vegas Sands and the other to the Saudi Arabian government. ■



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REQUIREMENT ATUL CHANDRA STANS

Pilatus waits on Indian PC-7 decision

Company ready to provide training in manufacture of turboprop if New Delhi places follow-on deal with domestic contractor

Swiss airframer Pilatus has quickly established itself as a trusted supplier to the Indian air force because of the smooth entry into service and performance of its PC-7 MkII basic trainer aircraft (BTA). As of last month, its in-service examples had exceeded 22,000 flying hours and accumulated well over 42,000 landings.

The last 15 PC-7 MkIIs currently under contract – aircraft numbers 61 to 75 – will be based at air force station Tambaram near the southern Indian city of Chennai. Tambaram will receive its first trainers in June 2015, where they will be used to prepare qualified flight instructors; a task conducted today on vintage Hindustan Aero-nautics Kiran MkII jet trainers.

An accelerated delivery schedule has already seen Pilatus deliver 51 trainers under a contract signed with New Delhi in 2012. The remainder are due to be handed over by August next year. Meanwhile, an option clause in the original contract for as many as 37 additional aircraft on top of the original 75 will expire in May, and is likely to be allowed to lapse.

“We want to execute our existing contract on time and to the full satisfaction of the Indian air force,” says Jim Roche, vice-president of government aviation and deputy chief executive of Pilatus, speaking at the company’s Stans site.

“We hope that over the next few months there would be a final clear guidance as to what particular road the Indian air

force is following to finalise its BTA requirements.”

In March, India’s defence ministry issued a request for information for the procurement of an additional 106 PC-7 MkII trainers under its “Buy & Make (Indian)” procurement category.

“We have been contacted by a large range of Indian companies who have approached us with regard to being the prime contractor should the decision be Buy and Make India, as in this situation Pilatus cannot be the prime,” says Roche. “Pilatus will provide detailed training to the successful Indian prime contractor on site here at Stans for the manufacturing and airframe assembly element of the programme.”



All 75 aircraft currently on order will be delivered by August 2015

One area that remains to be resolved is the conclusion of the maintenance transfer of technology contract with HAL. This will allow the Indian company to keep the PC-7 MkII’s systems and

components in line with the original equipment manufacturer’s agreed maintenance policy, ranging from detailed repair and overhaul capability to the replacement of components. ■

TESTING ATUL CHANDRA BENGALURU

Twin-seat Tejas trainer variant hits production standard

A twin-seat trainer variant of India’s Tejas Mk1 light combat aircraft has performed its first test flight from Bengaluru in a final series production configuration meant for the Indian air force.

Prototype vehicle six (PV-6) is the final prototype before commence-

ment of series production, and bears “all the major design modifications undertaken during the last 2,500-plus flights in the programme,” says the Aeronautical Development Agency (ADA).

The 35min sortie, with the aim of checking the design’s twin cockpit

functionality, was completed as planned. PV-6 is powered by a General Electric F404-IN20 afterburning engine, which will be common to all series production Tejas Mk1 single-seat fighters and twin-seat trainers for the Indian air force, as well as trainers for its navy.

Tejas Mk1 trainers will also have the capability to carry a wide range of air-to-air and air-to-ground ordnance, the ADA notes.

The lead air force trainer, PV-5, was first flown in 2009, with an initial operational clearance goal of December 2011. Seventeen Tejas aircraft have been flown since 2001, with the fleet having accumulated almost 2,800 flights to date. ■



The type is powered by a General Electric F404-IN20 engine

DEVELOPMENT

Close air support enhancement hits flight testing

Raytheon has started flight tests of the persistent close air support (PCAS) system, as part of the third phase of a US Defense Advanced Research Projects Agency effort to provide ground troops with faster and more accu-

rate close air support by sharing real-time situational awareness and weapons systems data.

PCAS will be installed on a Fairchild Republic A-10 Thunderbolt ground-attack aircraft to test its airborne perfor-

mance and connectivity with ground-based joint terminal attack controllers, Raytheon says. The technology should “help reduce close air support response times from as long as 1h to just 6min”, it adds.

Lead systems integrator Raytheon is working with partners Rockwell Collins, General Electric, BAE Systems and 5-D Systems under the three-year PCAS programme, which is worth a total of \$82 million. ■



UAV motherships would be 'aircraft carriers in the sky'
DEFENCE P26

MILESTONE CRAIG HOYLE LONDON

Tornado leaves Afghanistan as RAF turns sights on Iraq

Aircraft from 31 Sqn depart Kandahar, bringing to an end a decade of UK fast jet activity

The UK has concluded a decade-long commitment of fast jet combat aircraft to the NATO-led International Security Assistance Force in Afghanistan, with its last Panavia Tornado GR4s having left Kandahar airfield for the final time.

Aircraft on detachment from the RAF's 31 Sqn took off from Kandahar on 11 November, at the start of a return journey to their home base at Marham, Norfolk, via Akrotiri in Cyprus.

Seven RAF squadrons operated the Tornado in Afghanistan from June 2009 until the withdrawal, which comes as the UK and other ISAF contributing nations run down their combat involvement in the nation before year-end.

The RAF's deployed Tornados flew more than 5,000 pairs sorties during the type's contribution to the campaign, the Ministry of Defence says, with over 33,500 flight hours logged. Some 600 so-called "shows of force" were conducted using the aircraft through this time, to disrupt and deter activities by Taliban forces.

A combined total of around 140 MBDA Brimstone air-to-surface



The type flew more than 5,000 pairs sorties during the campaign

missiles and Raytheon Systems Paveway IV precision-guided bombs were released by Tornado crews through the entire period, with the RAF confirming a roughly 50:50 split in their use, which also involved their Rafael Litening III targeting pods.

More than 3,000 rounds were also fired from the type's 27mm Mauser cannon during more than 70 other engagements, the service says. They also employed UTC Aerospace Systems Raptor reconnaissance pods to provide ground surveillance, for example by spotting "potential hazards such as roadside bombs", the MoD says.

The start of operations with the Tornado from Kandahar followed an almost five-year deployment involving BAE Systems Harrier GR9s from the RAF and Royal Navy, the first of which arrived in Afghanistan in September 2004.

The UK's Tornados remain busy, with the type also currently providing part of the nation's contribution to the fight against Islamic State militants.

"Our operational focus and that of the Tornado force must now turn to Iraq where, as in Afghanistan, we will continue to support our allies," says chief of the air staff Air Chief Marshal Andrew Pulford.

RETROFIT GREG WALDRON ZHUHAI

Thunder fleet to receive upgrade

Pakistan is in the process of retrofitting its 50 Chengdu/Pakistan Aeronautical Complex JF-17 Thunder fighters to an improved Block II configuration, featuring improved avionics and software and a fixed air-to-air refuelling probe.

The Pakistan air force will begin taking delivery of its upgraded aircraft in December, says Air Cdre Khalid Mahmood, chief executive of JF-17 sales and marketing. Beyond this, the service has options to strengthen its fleet of the type to 150 or 200 aircraft, with further improvements foreseen in a planned Block III upgrade.

Mahmood spoke to *Flight International* at Airshow China in Zhuhai, where he was part of a 20-strong delegation which brought a single JF-17 to appear in the static display as part of an export sales drive. Pakistan recently sent a squadron of 18 aircraft to western China to participate in an air combat exercise.

The air force is satisfied with the fighter's Klimov RD-93 engine, says Mahmood.

The powerplant can currently be operated for up to 800 flight hours between overhauls, but there is an effort under way to improve this.

See Show Report P29

ACQUISITIONS ANDREW MCLAUGHLIN SYDNEY

Canberra makes formal request for extra C-17s

Australia has formally requested "up to four" more Boeing C-17 strategic transports from the US government, according to a 12 November notification from the US Defense Security Cooperation Agency (DSCA).

Including associated equipment, spare parts and logistics support, the proposed deal has an estimated value of \$1.6 billion, the DSCA says.

If all four aircraft are acquired, it will take the Royal Australian Air Force's fleet of the type to 10 examples, operated by 36 Sqn

from Amberley air base in Queensland. Defence minister David Johnston had on 3 October revealed Canberra's interest in acquiring between two and four more C-17s.

Production of the Globemaster will end in early 2015, with Boeing having been seeking buyers for a final batch of 10 'white tail' aircraft.

Interest in the remaining strategic transports is believed to exist with Canada, India, the UK and possibly new customers in the Middle East.

Six examples are in Australian service



DEVELOPMENT

Moscow tests powerplant for PAK DA bomber

Russian engine designer Kuznetsov has announced completing bench tests of a new propulsion system which is in development for Moscow's next-generation PAK DA bomber.

The Samara-based company on 7 November said the early test activity supports the Russian government's plan to complete first flight of the bomber by 2019. They also will validate research and development investments in a production version, says Kuznetsov executive director Nicholas Jakushin.

Russia's air force launched the development programme in 2009, selecting Tupolev – maker of its in-service Tu-95, Tu-160 and supersonic Tu-22M – to design the new aircraft. In June, state-owned media outlets quoted Kuznetsov officials as saying the company had won a competition to develop the bomber's new engine. It also supplied the engines for the trio of bomber types in current service.

Details of the new engine's architecture and performance have not been released, but pictures reveal proportions not unlike those of the Pratt & Whitney F135 used with the USA's Lockheed Martin F-35. ■

CONCEPT BETH STEVENSON LONDON

UAV motherships would be 'aircraft carriers in the sky'

US research agency wants to conduct full flight demonstrations within four-year period

The US Defense Advanced Research Projects Agency (DARPA) is seeking information from industry on existing technologies that would facilitate the deployment of small unmanned air vehicles from large manned aircraft.

DARPA says it envisages "aircraft carriers in the sky" that would be able to launch and recover small UAVs from existing types such as the Lockheed Martin C-130 Hercules.

"DARPA is interested in exploring the feasibility of small UAS airborne launch and recovery approaches for providing distributed airborne capabilities from existing air platforms," a request for information released on 7 November states. "The agency envisions a large aircraft that, with minimal modification, could launch and recover multiple small unmanned systems from a stand-off distance."

Military air operations traditionally use large, manned aircraft, placing such assets and their pilots at risk, while small UAVs are limited by their range and endurance, DARPA says.

"These complementary traits



The US Air Force's C-130J could host the technology

US Air Force

suggest potential benefits in a blended approach – one in which larger aircraft would carry, launch and recover multiple small UAS," it says. "Such an approach could greatly extend the range of UAS operations, enhance overall safety and cost-effectively enable groundbreaking capabilities for intelligence, surveillance and reconnaissance and other missions."

Responses are sought by 26 November, with technical, security and business insights to address the feasibility and potential value of the proposal.

"We envision innovative

launch and recovery concepts for new UAS designs that would couple with recent advances in small payload design and collaborative technologies," says Dan Patt, DARPA programme manager.

The agency is proposing to work towards achieving full-system flight demonstrations within four years.

"DARPA is interested not only in what system functionality such plans could reasonably achieve within that timeframe, but also how to best demonstrate this functionality to potential users and transition partners," it says. ■

UNMANNED SYSTEMS BETH STEVENSON LONDON

RAF Reaper makes first Hellfire strike inside Iraq

A Royal Air Force-controlled General Atomics Aeronautical Systems MQ-9 Reaper remotely piloted air system conducted its first offensive strike outside Afghanistan early this month, engaging Islamic State insurgents with a Lockheed Martin AGM-114 Hellfire air-to-surface missile.

Confirming the development on 10 November, the UK Ministry of Defence said the unmanned air vehicle was used to target militants who were laying an improvised explosive device near



Insurgents are being targeted

Bayji, north of Baghdad. The Reaper continued its mission by providing intelligence, surveillance and reconnaissance services for other coalition aircraft,

which the MoD says helped to facilitate further strikes.

The UK government in mid-October announced that the RAF was to redeploy an undisclosed number – believed to be two – of its 10-strong Reaper fleet from Afghanistan to support a US-led coalition in countering Islamic State activities in Iraq and Syria.

"There has been an increase in deployed Reaper aircraft numbers, which will allow the RAF to fly double the amount of intelligence and surveillance-gathering

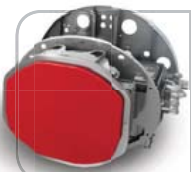
missions. Additional assets are planned to be deployed over the coming months," an MoD source says, while declining to comment on specific aircraft numbers.

Meanwhile, the UK government has received approval to begin flying surveillance-only missions over Syria using the Reaper in an unarmed configuration. The RAF's one Boeing RC-135W Rivet Joint signals intelligence aircraft also is to be operated over the country, in support of coalition activities. ■

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AIRSHOW CHINA

China has serious ambitions to become a world leader in aerospace, and nowhere is this more evident than at the biennial Airshow China event in Zhuhai. Although the skies were grey with pollution, the flying displays were impressive, featuring the dramatic arrival of two new Chinese military types on the world stage: the Shenyang J-31 fighter and the Xian Y-20 transport. Several of the nation's domestic airliner projects also announced fresh sales. Show report by Aaron Chong, Mark Pilling, Mavis Toh and Greg Waldron



DEVELOPMENT

Surprise show debut for experimental J-31 fighter

Without question, the most significant development at the show was the debut appearance of the Shenyang J-31 – China's most recent experimental fighter design.

AVIC officials were tight-lipped about the programme, with one source noting "it will be hard to get anyone to discuss this aircraft publicly". Regardless, it was telling that this aircraft, in addition to the Xian Y-20 transport, appeared at a Zhuhai show so early in the development programme.

The J-31's flying display routine was fairly conservative, most

likely due to a reluctance to push the type's envelope too far this early in development. The aircraft on show carried the marking 31001, indicating that it is the first flight test example, which took to the air for the first time in October 2012.

Dozens of large J-31 banners were also on display around the show site. This level of visibility could suggest a desire for greater transparency on the part of China, but also could indicate that Beijing wants to attract foreign buyers to help cover the high development cost of such a programme. ■



AVIC officials remain tight-lipped about the programme



Commitments for the regional ARJ21 now stand at 278 aircraft

ORDERBOOK

Comac bags new orders for twinjets

Chinese lessors CMB and Comsys (Tianjin) to buy C919 and ARJ21 as airframer prepares for certification challenge

Comac has announced two major commitments from Chinese leasing companies for its ARJ21 and C919 programmes.

At a press conference on the first day of the show, CMB Financial Leasing signed a memorandum of understanding with the Chinese airframer for 30 of its in-development C919 twinjet. This brings the total number of commitments for the programme to 430 aircraft.

CMB's president Guo Guang says developing a narrowbody aircraft is a "Chinese dream", and the firm has a duty to support the country's civil aviation industry.

Comac chief financial officer Tian Min says the lessor's commitment represents a "vote of trust" for the C919 programme, and that the manufacturer will strive to provide a safe, economical and comfortable commercial aircraft.

Flightglobal's Ascend Fleets database shows that CMB has a fleet of 20 aircraft, the majority of which are Airbus A320-family and Boeing 737 jets. The wholly-owned subsidiary of China Merchants Bank started operations in 2008.

Comac started final assembly of the first C919 prototype in September, and is working towards an end-2015 first flight target for the aircraft. The type has so far been sold largely to Chinese airlines and leasing companies.

In a boost for its other programme, Comac also won commitments from Comsys (Tianjin)

Aviation Leasing Company for 20 of its ARJ21-700 regional jets, which it says will be certificated this year. The Democratic Republic of Congo's transport ministry has also firmed an order for three ARJ21s, comprising two baseline passenger aircraft and one business jet variant. The nation signed a memorandum of understanding for the aircraft during the Farnborough air show in July. The announcements bring total commitments for the ARJ21 to 278 aircraft.

Comac appears to be on the brink of gaining certification from the Civil Aviation Administration of China for the ARJ21

Meanwhile, Comac appears to be on the brink of gaining certification from the Civil Aviation Administration of China for the ARJ21, with its leaders pledging that certification will come through before 2014 ends.

The Chinese airframer brought aircraft 106, which is due to be delivered to launch customer Chengdu Airlines, to the show. Company chairman Jin Zhuanglong also took his first flight on the Chinese-made regional jet, saying that it feels no different to an Airbus or Boeing aircraft. ■



**MA700 launch
customers
announced
SHOW REPORT P32**

SALES

CATIC courts export buyers for JF-17

CATIC has had discussions with seven or eight countries about the Chengdu/Pakistan Aeronautical Complex JF-17 fighter, but political upheaval in the Middle East has delayed a foreign purchase of the aircraft.

Speaking with *Flight International*, CATIC vice-president Zeng Wen says some countries could be getting close to signing a contract. This positive attitude mirrors comments by the company and Pakistani officials over the last few years.

One Pakistani source, however, says political turmoil in the Middle East following the Arab Spring revolutions has delayed take-up of the new type, which is designed to be a cost-effective fighter ideal for the air forces of developing nations.

The Pakistan air force sent a JF-17 to this year's show, but the



Pakistan operates the fighter

type did not perform in the flying display. There were also notably fewer military delegations from Middle Eastern countries at the event.

Zeng says CATIC and the Pakistan air force will continue to push for overseas sales, and will be present at other major air shows. He could not say, however, if the JF-17 will appear at the Paris air show in June 2015.

Longer term, Zeng foresees potential for China to sell advanced fighters like the Shenyang J-31

beyond the JF-17. "The development of technology will see our customers come to us with upgrade requests," he says. "This kind of high technology, advanced aircraft should meet somebody's request in the future."

Meanwhile, Zeng confirms that the Hongdu L-15 advanced jet/lead-in fighter trainer has found an export customer. He declines to specify the country or the number of aircraft involved, but Flightglobal's MiliCAS database records Zambia as having placed a firm order for six. Work is currently being undertaken with the type to increase the types of weapons it can carry.

"I'm confident the L-15 compares favourably to other trainers on the international market, such as the [Korea Aerospace Industries] T-50 and the [Irkut] Yak-130," says Zeng. ■

MANUFACTURING

Leap-1C enters build for C919 flight test fleet

Engine manufacturer CFM International says it is "very pleased" with the performance of its Leap-1C so far, and that it has started building engines to be delivered for Comac's C919 flight test programme.

Speaking to reporters, CFM International chief executive Jean-Paul Ebanga said development of the Leap-1C is "going well", and that the engine has garnered more than 75 flight hours on a Boeing 747 testbed since its maiden flight on 6 October.

"We're very pleased about where we stand today. We're on time and on specification. The programme will continue to do well between now and the development phase," he says.

Ebanga would not say when CFM is scheduled to deliver the first engines to Comac, but he stresses the company will support the Chinese airframer's timeline and deliver on time.

The engine is scheduled to be certificated in 2015, with Comac aiming to fly the C919 for the first time at the end of the same year.

"We're on time and on specification."

The programme will continue to do well between now and the development phase"

JEAN-PAUL EBANGA

Chief executive, CFM International



The type conducted its debut sortie in January 2013

DISPLAY

Y-20 makes grand entrance

Xian strategic transport wows with high angle of attack turns in flying routine over Zhuhai

Xian's new Y-20 transport made a major impression at the show, displaying its handling performance during the daily flying display.

The strategic transport made a number of passes of the Zhuhai site, and performed several high

angle of attack turns in its routine – reminiscent of past displays involving the US Air Force's Boeing C-17, an example of which also appeared on the static line.

The Y-20, which conducted its debut flight in January 2013, is likely to eventually replace some

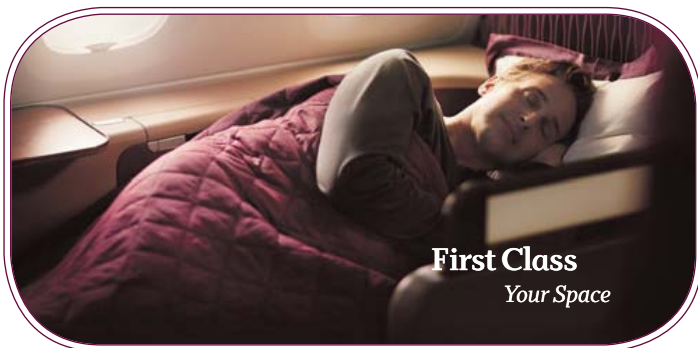
of China's current transports, including the Ilyushin Il-76.

In addition to the Y-20's debut appearance, the show also boasted a pair of Il-76s and a Chinese air force KJ-2000 airborne early warning and control system derivative. ■


OUR
A380

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27.90 m
24.93 m



MANUFACTURING

Bombardier could build Chinese final assembly line

Building a final assembly line could be “the next logical step” for Bombardier in China, according to Mike Arcamone, president of the Canadian company’s Commercial Aircraft unit.

Speaking to *Flight International*, Arcamone says a large proportion of manufacturing for the Dash 8 Q400 and CSeries aircraft is already being undertaken in China. AVIC’s Shenyang Aircraft Corporation makes the front, mid and aft fuselage for the turboprop, and the centre fuselage for the regional jet, he notes.

“We have the supply base and manufacturing footprint already in China, and maybe one day the next logical step would be to put all the parts together,” he says.

Arcamone says while Bombardier is “very keen” to develop a final assembly line in China, that

will only happen if there are enough orders to justify such an investment.

“Currently we can still supply [the aircraft] from North America, but if there is a market that requires a certain amount on a yearly basis, we do the economics and if it makes sense, we put in a final line,” Arcamone says. He adds, however, that no discussions have been started with possible joint venture partners.

There are currently 35 Bombardier CRJs flying in China. The airframer has also experienced further success in the nation recently, comprising of orders for 25 CRJ900s from China Express Airlines and a letter of intent for 30 Q400s from Nantong Tongzhou Bay Aviation Industry, to be operated by start-up Sutong Airlines. Loong Air has also inked a



The CSeries’ centre fuselage is already made in the country

letter of intent for 20 CSeries aircraft, while CDB Leasing has a conditional purchase agreement for 15 of the type, plus 15 options.

China imposes an import tax of up to 24% for aircraft with a capacity of below 90 seats, effec-

tively preventing foreign manufacturers from competing in the market. There are no Bombardier or ATR turboprops in China, with domestic types including the AVIC Xian Aircraft MA60 and MA600. ■

DEVELOPMENT

MA700 launch customers announced

Domestic carriers Joy Air and Okay Airways sign up for 70-seat turboprop, as airframer AVIC targets Western certification

AVIC has announced Joy Air and Okay Airways as launch customers for its in-development MA700 turboprop programme.

The two Chinese carriers will now be involved in the development of the 70-seat turboprop to ensure that the aircraft meets market demands, the programme’s chief engineer Dong Jian Hong said during a signing ceremony at the show.

The airframer did not disclose the number of MA700s the airlines will order.

Dong says the target is for the MA700 to make its first flight in 2017, and to be certificated by the Civil Aviation Administration of China in 2019. Thereafter, the airframer will seek certification from the US Federal Aviation Administration – making it the first Chinese-made turboprop to apply for Western approval.

Joy Air and Okay Airways are existing operators of the older



A mock-up of the type’s fuselage and cockpit was at the show

MA60 turboprop, and AVIC believes their involvement will help push the MA700 programme forward.

The MA700 will compete with ATR and Bombardier in the large turboprop market. AVIC says its design will have a speed just under that of the Bombardier Dash 8 Q400, and the operating economics of the ATR 72.

Speaking to *Flight International*, AVIC Xian Aircraft Industry vice-president Wang Chengkuan claims that the Chinese-made aircraft will be the first turboprop in the world to adopt a fly-by-wire flight control system.

A product brochure for the MA700 shows that the aircraft will have a maximum take-off weight of 26,500kg (58,400lb)

and a maximum range of 1,460nm (2,700km), although it is best positioned to serve markets within a 430nm range. The aircraft can be configured for between 68 and 86 seats.

For the first time, AVIC showcased a large-scale mock-up of the MA700’s cockpit and fuselage. Wang says the company is forecasting demand for more than 2,000 regional turboprops in the 60-99-seat range over the next 20 years, and that its target is to gain a one-third market share.

AVIC also stresses that the MA700 is a brand-new aircraft, with no “blood relations” to the MA600 and its predecessor, the MA60. The existing models have mostly been sold to airline customers in developing countries in Asia and Africa. Flightglobal’s Ascend Fleets database records a combined 68 examples as being in operation, including with military customers. ■



Powerful display
SHOW REPORT P34

STRATEGY

Airbus touts regional A330 benefits

Company reports receiving “positive feedback” about proposed reduced-weight variant, with Chinese market a key target

Airbus believes its regional A330 is the best short-term solution to ease the key constraints in the Chinese market.

Speaking to *Flight International*, Airbus China president Eric Chen says he does not see how China could “in a short while overcome” issues related to congestion at its airports, plus air traffic control constraints and a shortage of pilots.

“The regional A330 is not a miraculous solution, but it’s definitely a solution to relieve the pressure,” he says.

Airbus launched the regional A330 at the Aviation Expo in Beijing last year, aiming the aircraft largely at the Chinese market. Chen says he has since received “a lot of positive feedback” from discussions with customers about the variant, and believes Chinese airlines will seriously consider the type when they order new aircraft under Beijing’s 13th five-year plan, covering 2016-2020.

He adds, however, that there has also been “some confusion” that the lower-weight variant means carriers will not be able to operate the aircraft long-haul.

A regional A330 would only involve “paper changes” and some adjustments to strengthen the aircraft’s landing gear, he notes, while the cabin could also be reconfigured to remove some galleys and put in more seats.

Airlines could use it for mixed short-haul or medium-haul operations to increase utilisation

The official stresses that the aircraft will have “full flexibility”, and that airlines could use it for mixed short-haul or medium-haul operations to increase utilisation. The lower weight will also bring savings in landing fees



The type was launched at the 2013 Aviation Expo in Beijing

and navigation charges. Chen says the aircraft can be made available in 2016, and counters a Boeing claim that Airbus is effectively pitching “old, obsolete technology” to China with its regional A330.

“You’re not agreeing to buy a product because it’s new,” he says. “What’s key is which product matches, more economically, the market requirements. Which matches the airline’s strategic development plan. Which product is most popular to customers and which product better serves the

airline’s strategy. These are fundamental questions, it’s nothing to do with [whether the product is] new or old.”

Airbus featured the A330 prominently on banners and posters at the show. The company also brought A380 test aircraft MSN001 to the show, where it participated in the flying display and appeared in the static park.

The company has so far sold only five superjumbos in the country, with these aircraft now in operation with China Southern Airlines. ■



ROTORCRAFT

Avicopter promotes new light twin

Chinese manufacturer Avicopter used the show to promote its twin-engined AC3X2 light helicopter, exhibiting a large mock-up the rotorcraft, which is configured to carry seven passengers. Avicopter sees a number of potential roles for the type, including search and rescue, emergency medical services, law enforcement and VIP transport duties. The company first revealed the AC3X2 design at the Heli-Expo convention in the USA in February.

ORDERBOOK

Reignwood to add more Bell 505s to tourist fleet

Bell Helicopter has signed a letter of intent with Chinese company Reignwood Investment for an order of 50 Bell 505 Jet Ranger X helicopters, bringing its total commitment for the new model to 60 examples.

The airframer, which displayed full-size mock-ups of both the 505 and its in-development 525 Relentless at the show, says Reignwood will use the aircraft for travel and tourism purposes. The operator’s existing fleet also includes Bell 206s, 407GXs and 429s, and it had previously signed for 10 of the new type.

“We are pleased to work with Bell Helicopter on this agreement, and are confident the new Bell 505 is the ideal solution to

meet our requirements,” says Reignwood director of aviation Zheng Gang.

Bell’s latest order was announced two days after it conducted the successful first flight of the 505 at its Mirabel manufacturing facility in Quebec, Canada. The company says it has now secured interest in 240 of the aircraft, including letters of intent for 20 other examples in China.

The five-seat, single turbine-engined helicopter is powered by a Turbomeca Arius 2R and also features Garmin’s G1000H integrated avionics suite.

Bell also announced the sale of six more Bell 407GX aircraft to four Chinese operators during the show. ■



POWERFUL DISPLAY

Visitors to this year's event in Zhuhai were treated to a daily flying schedule including new military types, plus aerobatic specialists and commercial offerings aplenty. A tour of the exhibition halls also provided an insight into Beijing's ambitious development activities





(Clockwise from main) A pilot from the August 1st display team prepares to get airborne; ARJ21 nears delivery; Russian Knights bring added flare; Y-20 in model form; Su-35 on the

climb; the United Arab Emirates' Al Fursan team; KJ-2000; J-31 model shows strong resemblance to F-35; J-10s of the August 1st team; Airbus A380 pays a visit





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Early adaptors
FEATURE P38

CHARTER KATE SARSFIELD LONDON

Royal Jet boosts fleet with two BBJs and two Globals

Abu Dhabi-based operator hints at refurbishing rather than replacing existing Boeings

VIP charter company Royal Jet has acquired four new high-end business jets as part of a \$700 million spending commitment on new aircraft over the next decade.

The Abu Dhabi-based operator has ordered two Bombardier Global 5000s, which will replace its Gulfstream G300s when they enter service this month and in February next year. The super-large business jets will be used for charter and medical evacuation services, alongside Royal Jet's midsize Learjet 60/XRs.

Royal Jet has also acquired two Boeing Business Jets, which will be delivered "green" next year. Negotiations are now under way with completions centres, the privately-owned company says. The firm is the world's largest operator of BBJs, with a fleet of six aircraft.

The company announced plans last year to replace the BBJ fleet, and has been evaluating the Airbus ACJ319 and Bombardier CSeries alongside the BBJ Max family as possible platforms.

"We are still evaluating other models. No decision has been made yet," says Patrick Gordon,



The high end operator is acquiring a further two BBJs

who was appointed Royal Jet's chief executive last month following the departure of Shane O'Hare. Gordon is keen to retain some of the BBJs for Royal Jet's thriving charter business. "If the economy continues to grow and demand increases, I would refurbish the aircraft and keep them in the fleet. I hate to get rid of assets that could generate business," he says.

Royal Jet launched operations a decade ago, and during that time the BBJs have undergone "soft" refurbishments every two years and major refits every five. "We have been profitable every year for the last eight years," Gordon adds.

As its business expanded, Royal Jet started to broaden its focus. Late last year it joined forces with Air Seychelles to establish the country's first fixed-base operation. The facility – Royal Jet's only FBO outside its Abu Dhabi International airport base – is a response to the growing number of private aviation tourists from the Middle East, Europe and the CIS visiting the island nation, Gordon says.

Royal Jet is looking to expand its FBO portfolio, but Gordon will not disclose which destinations the company is evaluating. "It will be in one of the [145] countries that we currently fly to," he says. ■

MANUFACTURING
KATE SARSFIELD LONDON

New home for Piaggio as EVO gets ready to go

Piaggio Aerospace has opened its new global headquarters at Villanova d'Albenga, 80km (50 miles) southwest of Genoa.

The 127,000m² (1,370,000ft²) facility houses a 49,000m² plant dedicated to the development and manufacturing of the airframer's P180 Avanti-based twin-turboprop programmes, as well as its engine component assembly business.

This new base replaces the Italian airframer's more than 90-year-old plant in Finale Ligure, which becomes a dedicated service centre for the Avanti fleet.

Piaggio – a subsidiary of Abu Dhabi's state investment arm Mubadala – is developing three versions of the distinctive twin-pusher. The special missions vari-

The new base replaces the airframer's more than 90-year-old plant in Finale Ligure

ant, known as the Multirole Patrol Aircraft, is earmarked for certification and service entry in 2016. Its unmanned air vehicle, the P1HH Hammerhead, is scheduled to enter service next year, while its third-generation civil P180 – the EVO – is expected to receive European validation this month.

The \$7.4 million EVO was launched in May as an upgrade to the nine-year-old Avanti II, which remains in production. The EVO features a revamped and quieter interior, enhanced safety features and increased performance, thanks to winglets, redesigned engine nacelles, a reshaped front wing and five-blade composite scimitar propellers. Flight testing of the EVO began in February, and the test aircraft has so far clocked up around 100h, says Piaggio. "We hope to receive European approval this month and deliver up to four aircraft before the end of the year," it adds. ■

APPROVAL KATE SARSFIELD LONDON

China certificates Nextant's 400XTi

Nextant Aerospace has clinched Chinese certification for its 400XTi business jet, paving the way for the US airframer to deliver the first of the remanufactured light twin-engine type into the region early next year.

Nextant has appointed AVIC International Aero-Development as exclusive sales representative for Greater China for both the XTi and its in-development G90XT twin-engine turboprop. To support the region's growing fleet,

the Cleveland, Ohio-based company has also appointed Beijing-based STAECO Business Jet Maintenance as its first authorised service centre.

The seven-seat 400XTi was launched last year as a quieter and roomier version of Nextant's 400XT – itself a remanufactured and re-engined Beechjet/Hawker 400A/XP.

The type features Williams International FJ44-3AP engines and a Rockwell Collins Pro Line 21 integrated flightdeck.

Nextant expects the global in-service fleet of XT/XTis to reach 50 aircraft before the end of the year, across 10 countries.

The G90XT is an upgraded version of the Beechcraft King Air C90 featuring General Electric H75-100 engines – the first twin-turboprop application for the powerplant – and a Garmin G1000 flightdeck.

The G90XT is scheduled to make its maiden flight before the end of the year, leading to first deliveries in 2015. ■



EARLY ADAPTORS

The first operators of the Boeing 787-8 had entry into service delays and a battery crisis to contend with. What has their experience with the Dreamliner been so far?

STEPHEN TRIMBLE

WASHINGTON DC, ADDIS ABABA, SEATTLE

All Nippon Airways introduces Masami Tsukamoto as the first airline pilot outside Boeing who was allowed to take the controls of the 787-8. When the day finally came to fly the first Dreamliner delivered to ANA from Seattle to Tokyo, Tsukamoto's reading on the pre-flight fuel gauge still surprises him three years later.

As a career ANA captain, Tsukamoto had flown the Seattle-Tokyo leg many times in different aircraft. He knows by memory that a



747-400 needs at least 136,000kg (300,000lb) to make that trip. The smaller, leaner 777-300ER needs nearly 100,000kg. For the 787-8, the fuel gauge that drizzly September day in Seattle read 63,500kg for the Pacific crossing.

"When I looked at the [fuel] quantity, I couldn't believe that these were good enough," Tsukamoto said in a recent interview at ANA's headquarters in Tokyo.

Tsukamoto is not alone. In Warsaw, LOT Polish Airlines chief executive Sebastian Mikosz says the 787 is "like a glider", describing an average fuel flow per hour of only 2t (4,4100bs), compared with his fleet average of 4.6t. In Addis Ababa, Ethiopian Airlines chief

pilot Yohannes Hailemariam says the fuel load that pushes a 767-300ER to Rome can propel a 787-8 to Frankfurt, nearly 20% further on a direct line. In Luton, UK, Thomson Airways managing director John Murphy says the 787 is also demonstrating nearly 20% improvement, a figure that is "good for us".

PERFORMANCE

Flight International has visited five early operators with a combined fleet of 71 787s now in service on three continents, and the theme is that the aircraft has delivered on Boeing's contractual fuel-efficiency guarantees. This performance – combined with the aircraft's

ability to connect secondary markets at ranges well beyond the reach of its predecessors – has sustained the 787 in the market despite waves of technical glitches.

Three years after the 787 entered service, 24 airlines operated 193 of the aircraft as of early November, according to Flightglobal's Ascend Fleets database. That represents 42% of a backlog of 456 aircraft. Including the combined orderbook of the 787-8, -9 and -10, Boeing has delivered 18% of the backlog so far, including five 787-9s to three carriers since July.

To sustain the backlog, many things could go wrong after entry into service, but fuel

GROUNDING

MIXED REACTIONS TO BOEING'S BATTERY FIX

EIGHTEEN MONTHS after the US Federal Aviation Administration lifted the grounding order on the Boeing 787-8 fleet, the two rechargeable lithium-ion batteries installed in the aircraft produce mixed reactions among operators.

For some, Boeing's redesigned installation and improved battery monitoring software that lifted the FAA's nearly four-month grounding order in 2013 is enough.

"As long as it's reliable, we don't have any issues with [the battery]," says Michal Leman, LOT Polish Airlines director of product development. "[The] FAA approved it. All security institutions approved it. We don't have any issues of [overcharging] or getting hot. Nothing such as that has happened."

Other operators in the fleet are less comfortable.

Boeing redesigned the internal layout of the battery but retained the lithium-cobalt-dioxide chemistry, with eight cells storing 72Ah of power.

"For me, the message [from Boeing] is the battery will still catch fire probably," says Yohannes Hailemariam, Ethiopian Airlines chief test pilot. "But when it catches fire, the smoke will not come to you. That is what they say to us, I think. That is what I understood."

Although Hailemariam used the word "fire", Boeing

"For me, the message [from Boeing] is the battery will still catch fire probably"

YOHANNES HAILEMARIAM
Chief test pilot,
Ethiopian Airlines

says the redesigned installation should prevent any flames in the first place. The new installation, however, does not prevent a cell from "venting", a thermal event that spews heat and vapour from burning electrolyte outside the cell container. The new design is intended to keep the heat contained to the venting cell, while the heat and smoke are channelled directly off-board. The goal is not to guarantee that a battery will never fail, but to prevent a venting cell from causing further damage to the aircraft or its crew and passengers.

Hailemariam is well briefed on the new battery system, but Boeing's explanation does not satisfy him completely. Asked if he would prefer a different kind of battery, he replies, "Yes. Number one, what caused that issue, you know? Why

did the battery catch fire?"

So far, investigation teams in Japan and the USA have not been able to answer what caused the 787 batteries to malfunction. The US National Transportation Safety Board plans to release a final report within weeks, but so far it has not identified the root cause of the battery meltdown in a Japan Airlines 787-8 parked at Boston Logan International airport on 7 January 2013.

MALFUNCTION

The Japan Transport Safety Board (JTSB) investigated the 16 January 2013 battery failure on an All Nippon Airways 787-8. The final report identifies an internal short circuit in one of the eight cells as the likely reason the battery overheated, but the investigators do not understand what caused

the short circuit.

After the second battery failure, the FAA grounded the six 787-8s United Airlines had in service, and regulators all over the world followed the US government's example. While the root cause is still a mystery, Boeing addressed the risk in two ways, making it harder for the battery to overheat with better monitoring software and preventing a battery that does overheat from damaging the aircraft or exposing passengers and crew to fumes and smoke.

"Overall, we're satisfied that the fixes we've implemented do prevent any airplane-level event," says Mike Fleming, Boeing's director of 787 services and support.

The redesigned installation received its first test a year after the battery groundings. Earlier this year,

» consumption is not one of them. Boeing promised a 20% fuel-burn reduction compared with a 767-300 delivered in the early 2000s.

QUEUING UP

Airlines might accept a long list of programmatic and operational errors that in another era may have seemed devastating. For the 787 programme, the setbacks seem almost unsurvivable in retrospect, including a 3.5-year delay of first delivery, supply chain breakdowns, repeated setbacks on the assembly line, three problems with lithium-ion battery cell venting, a four-month grounding, and "teething" issues that persist even as the 787 approaches airframe adolescence.

After all that, the 787's customers would not be so willing to queue for years to obtain the aircraft if Boeing also missed the mark on fuel performance. While some airlines complain that the 787-8 still falls short of the 20% mark listed in the 787 sales literature, they agree that the fleet average beats the contractual minimum.

Each airline measures and prioritises fuel efficiency in different ways, so the publicly released performance figures on the 787 cover a lot of ground.

787 dispatch reliability is "getting better slowly but surely", says Japan Airlines





Investigators are unsure what caused battery malfunction

on 14 January, a single cell of a lithium-ion battery on a parked JAL 787-8 vented. Boeing's new system worked. The overheated cell did not propagate enough heat to cause adjoining cells to vent. Smoke generated by the malfunctioning cell was vented directly out-

side, where it was spotted by airport staff. There was no damage besides the battery cell.

The incident, however, did not go unnoticed. The JTSB noted in its final report that the cell overheated in January – the same month as the two previous

battery failures. The Japanese investigators were unable to confirm the timing as a factor, but they raised the possibility of a cold-soak problem.

CONCERNS

Not all of Boeing's customers are satisfied that the redesigned battery installation is a sufficient answer. In addition to concerns about cell venting, some airlines are dissatisfied with the functional reliability of the battery.

"The rate of failures and frequency of failures is more than what the design is intended to be," says one senior airline executive. "In that sense, we are not satisfied. So we are talking to Boeing about the possibility of design improvement. Also, in terms of manufacturing process management, there may be an opportunity for an

improvement."

So far, Boeing is not promising any further changes, but it certainly has not closed the door.

"When you ask if we're satisfied, we're going to continue to look for improvements in the battery system and every system on our airplane," Fleming says. "From that standpoint, we'll continue to be participants to the investigations into why a cell vented."

Meanwhile, airlines continue to keep a close eye on the battery system's reliability and safety. "Every day, real-time, we are monitoring the voltage and the current," says Masaru Nishiwaki, ANA's deputy director of engineering and maintenance. "We sometimes sample [at intervals] of three months, six months and 12 months. We remove the battery and send it [to

battery supplier GS Yuasa], and ask them to review if something is wrong. At this point, no negative report has come from them."

For now, Boeing's options are limited as it waits for the NTSB to release a final report on the first JAL battery incident.

Airbus adopted a completely different approach when it decided to make lithium-ion batteries standard on the A350-900. Instead of using two large batteries containing eight cells, the A350-900 is equipped with four smaller batteries, each divided into 14 cells.

"While our customers understand and are comfortable with the changes we've made on the airplane," Fleming says, "there are some that would still like to see a battery that doesn't vent." ■



"When every airline is flying different missions with different configurations, the fuel-savings advantage will be different for each one," says Mike Fleming, Boeing's vice-president for 787 support and services.

At the bottom end of the scale, LATAM Airlines group, whose Chile-based subsidiary LAN Airlines operates nine of 26 Rolls-Royce Trent 1000-powered 787s currently on order, says in an email that its 787-8 fleet averages a 12% fuel cost reduction compared with its 767-300ERs. That seems low compared with Boeing's 20% target, but there are different assumptions involved. LATAM wraps fleet acquisition and operating costs into the equation. The carrier also operates newer 767-300ERs equipped with winglets, neither of which Boeing factors in to the 20% fuel-burn reduction it promises.

"LAN, as Americas launch customer, is getting some early production 787-8s which may not provide the best measure of the type's performance," says Richard Aboulafia, vice-president for analysis at Teal Group.

On the other extreme are Air Canada's expectations for the Dreamliner. After taking delivery of its first two General Electric GENx-1B-powered 787-8s earlier this year, chief executive Calin Rovinescu told analysts

» that he expected the aircraft to yield 29% lower unit-seat-mile cost than the 191-seat 767-300s that are being replaced. In a second-quarter earnings call, Rovinescu cited the example of the Toronto-Tel Aviv route, on which a 251-seat 787-8 can carry 31% more passengers and more than triple the cargo while burning 3% less fuel per trip than the 767.

“We have not yet reached the 20% target, but we are coming closer to 20%”

EISUKE HAMA

Aircraft performance group director, Japan Airlines

More typical are the airlines we visited, which occupy the vast middle ground between the LAN and Air Canada extremes.

All Nippon Airways, the 787-8 launch customer, reported in May 2012 – after starting revenue service the previous October – that the Trent 1000-powered 787-8s in its fleet burned 17% less fuel on domestic routes and 21% less fuel on long-haul routes on a per-seat basis when compared with a virtual model of a comparable 767. Asked for an update two years later, ANA deputy director for engineering Masaru Nishiwaki says fuel performance remains the same.

In another Tokyo office, Japan Airlines calculates fuel burn by measuring the amount of fuel used per person on board an aircraft, says aircraft performance group director Eisuke Hama. “We have not yet reached the 20% target, but we are coming closer to 20%,” he says. Hama adds that the introduction of engine upgrades, such as the second performance improvement package (PIP2) for the GEnx-1B, means that “fuel efficiency is gradually improving”.

RELEARNING

Another key factor in reducing fuel consumption is learning how best to operate a new aircraft.

“You can always make that 0.5-1% impact if you work collaboratively,” says Thomson’s Murphy, who operates eight GEnx-1B-powered 787-8s. “It’s about the design of the aircraft, the engines and how you fly it. Direct routing, at the planning stage, is very important. We want to maximise the optimum altitude, we want to have the pilots asking for shortcuts, and we want the perfect descent profile.”

LOT’s pilots have been flying the 787 since the battery grounding ended in May 2013. (LOT’s inaugural 787 flight from Warsaw to Chicago on 16 January 2013 was famously cancelled due to a 787 grounding order caused by two cases of lithium-ion battery fires.) One quarter of LOT’s pilots are still becoming familiar, but the majority of the »

787-8 DELIVERIES WITH ENGINE CHOICE

Operator	Headquarters	Engine	Number
Abu Dhabi Presidential Flight	Abu Dhabi	GEnx	1
Aeromexico	Mexico City	GEnx	5
Air Canada	Montreal	Genx	5
Air India	New Delhi	Genx	16
All Nippon Airways	Tokyo	Trent 1000	31
Arkefly	Amsterdam	GEnx	1
British Airways	London	Trent 1000	8
China Southern Airlines	Guangzhou	GEnx	10
Ethiopian Airlines	Addis Ababa	GEnx	10
Hainan Airlines	Hainan	GEnx	8
Japan Airlines	Tokyo	GEnx	15
Jetairfly	Ostend	GEnx	1
Jetstar	Melbourne	GEnx	7
Kenya Airways	Nairobi	GEnx	6
LAN Airlines	Santiago	Trent 1000	9
LOT Polish Airlines	Warsaw	Trent 1000	6
Norwegian	Oslo	Trent 1000	7
Qatar Airways	Doha	GEnx	18
Royal Brunei	Bandar Seri Begawan	Trent 1000	4
Royal Jordanian	Amman	GEnx	3
Thai Airways	Bangkok	Trent 1000	3
Thomson Airways	Luton	GEnx	8
United Airlines	Chicago	GEnx	11
Xiamen Airlines	Xiamen	GEnx	2

SOURCE: Ascend Fleets



ANA says Trent 1000-powered 787-8s burn 21% less fuel per-seat than 767 on long-haul

The Boeing 787 is greater than the sum of its parts.
And some of its parts are truly amazing.



Boeing is building a super-efficient airliner, and we're proud to do our part. Several parts, in fact, including the all-composite forward section, the wing's leading edges and engine pylons. Spirit leads the world in composite manufacturing, especially when it involves large and complex curves. Our composite work helps the Boeing 787 require significantly less fuel as it moves airlines and their passengers to a brighter and greener future.

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» carrier's 787 crews have learned how to maximise the fuel efficiency of the aircraft, says LOT director of product development Michal Leman.

"Pilots can go through numerous simulator lessons, but they also have to learn," Leman says. "You need to feel the aircraft when you are landing – when to put the engine on, when to stop using the engine and start gliding."

The 787's customers talk frequently about the 787's "gliding" effect. Although the engines remain powered, the shaping of the wing – which flexes up to 3.66m (12ft) in 1G flight – and the use of flight controls to manage structural loading on the wings means the aircraft often feels to the pilot that it is maintaining altitude using aerodynamic lift alone.

LOT's Mikosz recalls sitting in the cockpit on a 787-8 flight from Warsaw to Beijing, which requires a relatively rapid descent after crossing the Gobi Desert.

"Normally with a 767 it was like a stone – you idle down [the engines] and [the aircraft]

goes down," Mikosz says. "Here, [the pilot] said, 'My glider doesn't want to go down.' So she air-braked, she [moved the engine throttles] to idle and pushed the aircraft down. And it was [still] gliding."

AERODYNAMIC

Fuel efficiency is not only a function of the aerodynamic properties of an aircraft. Operational performance can make a substantial difference. In fact, a non-aerodynamic drag on fuel efficiency has been the 787's reliability problems, especially in the early days.

"In the beginning, it was difficult, because if you enter a new aircraft into your fleet you have all the time these small issues," says Leman. "So then you have 5min delay, 10min delay. From the perspective of the customer, it doesn't matter, because they are flying 8h and will arrive on time. But to reach [the destination] on time you have to burn fuel because you have to go faster."

Every new commercial airplane goes through teething issues as it goes from flight test to revenue service. The 777 set Boeing's benchmark for despatch reliability, but even it drew a public rebuke from launch customer United Airlines. The carrier complained a year after the aircraft's 1995 entry into revenue service that Boeing was slow to resolve an assortment of technical snags. These ranged from gearbox reliability problems with the General Electric GE90 to a leaky passenger exit door that froze shut.

At the depths of the battery crisis in early 2013, Boeing said the 787 was performing better on reliability problems than the 777, citing slightly higher despatch reliability and slightly fewer technical error reports, called EE-1s, submitted to the US Federal Aviation Administration.

A year and a half later, the 787's rate of progress has diverged from the standard set by the 777, as niggling technical issues continue to lower despatch reliability below Boeing's expectations for the aircraft's design.

"From a reliability standpoint, we're a little behind where the 777 was at this stage," Fleming says.

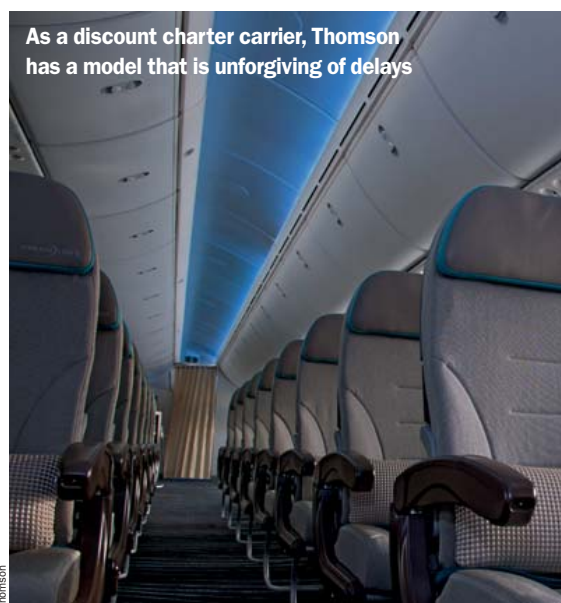
As more time passes, however, comparisons with the 777 begin to lose meaning. Thirty-six months after the first 777-200 entered revenue service, Boeing had delivered 151 examples of the 777-200, 200ER and 300 to 16 customers, according to Boeing's online delivery database.

Boeing delivered 198 787-8s and 9s to 25 operators over the last 36 months, while ramping up production to 10 aircraft per month. Not every airline has complained about 787 despatch reliability. Earlier this year, Boeing announced that one 787 customer had received an award for operating its first aircraft 100 days without recording a single

Achieving optimal fuel economy about how 787 is flown as well as its design, says Thomson



As a discount charter carrier, Thomson has a model that is unforgiving of delays



delay related to an onboard technical problem. Although that carrier has never been named, it is almost certainly Thomson. As a discount charter carrier, it has a business model that is unforgiving of delays that are solely the fault of the airline. More to the point, Thomson is virtually alone among 787 customers with no complaint about the aircraft's reliability.

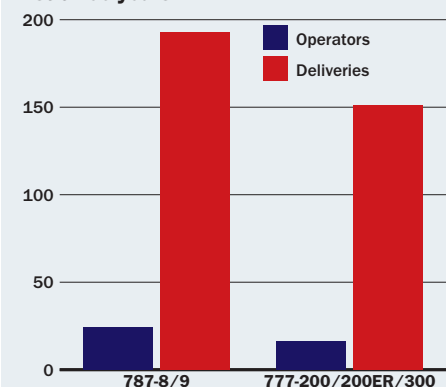
"You need to feel the aircraft when you are landing, when to put the engine on, when to stop using the engine and start gliding"

MICHAL LEMAN

Director of product development, LOT

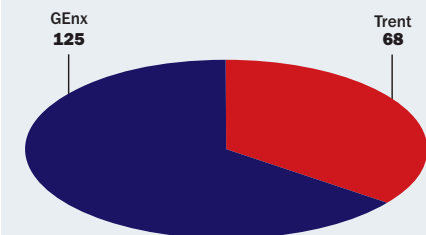
787-8/777 COMPARISON

First three years



SOURCE: Ascend Fleets

IN-SERVICE ENGINES SPLIT



SOURCE: Ascend Fleets



Murphy boasts that Thomson has “the most reliable 787s in the world”, despite having one of the highest utilisation rates.

“But we work hard at it,” Murphy says. “We’re constantly reviewing our spares stock and constantly reviewing our despatch reliability. We have a fantastic relationship with Boeing.” For most other airlines, despatch reliability remains a sore point. Earlier

this year, Boeing executives openly discussed a goal of reaching 99.5% fleet-wide despatch reliability by the second quarter of next year, matching the benchmark achieved by the 777-300ER.

In real terms, the difference between 98.5% and 99.5% can be significant to a carrier’s bottom line. ANA, for example, currently operates about 100 787-8 and 787-9 flights combined each day, so that percentage point represents the difference between one and three flights delayed by technical faults every two days.

As 2015 approaches, the target despatch reliability for the 787-8 discussed in public by Boeing executives is no longer 99.5%, but simply a rate over 99%. Three years after entry into service, the 787-8 is still running below Boeing’s design standard, which means the teething issues have still not gone away.

“From our past experiences we understand what it takes to get an airplane to consistently operate above our goal of 99% schedule reliability,” Fleming says.

Like fuel-efficiency targets, despatch reliability is prioritised differently by each airline. ANA, for example, remains slightly dissatisfied with the 787-8’s performance, even though it says its 787-8s have achieved a 99.5% despatch reliability average.

“Our target is 99.7,” Nishiwaki says.

Japan Airlines, meanwhile, has a target despatch reliability rate for its 787 fleet of 99.3% but is now running at 98.6%, says Hama.

“It’s getting better slowly but surely,” Hama adds. “It’s still not there yet.”

Boeing has not released the average despatch reliability rate across all airlines, but one airline executive says it is hovering at 98.3%.

As another early 787 customer, state-owned Air India has an obligation to submit written replies to questions from members of parliament, some of whom have sent regular queries about the 787’s reliability levels. On 14 July, Air India reported 318 service delays on the 787 between first delivery in September 2012 and June 2014.

The key issues driving delays also are a moving target for each airline.

In Addis Ababa, a critical problem for Ethiopian Airlines is a persistent glitch with the 787’s four cabin air compressors (CACs).

“It’s still an issue where every time you fly, there’s one compressor not working,” says Hailemariam.

Other carriers, however, had few complaints about the compressors. Hama says the CACs on JAL’s 787s have had “little, minor troubles”. At ANA, Nishiwaki says the reliability of the CACs is “very, very good”.

Indeed, the part number of the CACs in the ANA 787 fleet has remained the same since entry into service more than three years ago.



Starter/generators have proved problematic

Other parts in the electrical system have been redesigned several times over the same period, he says, so that the part numbers are augmented with a “-2”, “-3” or even “-4”, but not the CACs.

Boeing is addressing some “reliability issues that we have” on the CACs, a source at the company says.

Ethiopian expects the CAC issue to continue, says Zemene Nega, managing director for maintenance, repair and overhaul. “It is just a fundamental design issue,” he says. “It’s not going to be fixed with software.”

GENERATING TROUBLE

One of the universally problematic parts for airlines has been the variable-frequency starter/generators (VFSGs). There are two on each engine, and they represent one of the major innovations introduced by the 787. In all other commercial aircraft, functions such as cabin pressurisation and wing de-icing are powered by bleeding compressed air from the engine. To improve fuel efficiency, Boeing converted those systems to electric power. That required significantly more powerful engine-mounted generators, so Boeing introduced VFSGs on the 787 that each produce up to 250kVA of electricity.

“We have experienced a lot of troubles with the VFSG,” Hama says.

It is an issue that Boeing acknowledges has been a long-term problem, and one that may still not be completely solved. So far, Boeing has rolled out three improved versions of the VFSG, with each upgrade requiring a reinstallation.

“We expect that the latest configuration of the VFSG is the one that we will have for quite a while,” Fleming says. “While we know that further issues may arise, so far the data says that the VFSG reliability is improving.”

As each new version of the VFSG becomes available, airlines face another headache. The VFSGs deliver significantly more power than integrated drive generators on bleed-air systems, but they are also heavier.

“Each component is getting bigger and bigger,” one 787 airline customer says. “The weight of the VFSG is 200lb. It is so difficult to replace.”

Boeing provides tooling, such as slings, to help airline maintenance workers remove heavy equipment. Airlines also have taken

» more elaborate steps, such as pulling 787s out of service for 10 days to simultaneously fix various reliability issues, such as the VSFG. Air India reported to parliament that each aircraft in its fleet was grounded sequentially for a 10-day period between December 2013 and March 2014.

According to Fleming, more weight is one of the trade-offs of the design process. The VSFG units may be heavier than previous kinds of generators, but they replace a much heavier pneumatic power system, which feeds into the aircraft's overall fuel efficiency.

IMPROVEMENTS

Other reliability problems have all but disappeared or are being addressed. Earlier this year, Boeing reported that electromechanical actuators for 787 spoilers were one of the two biggest reliability headaches, but the issue was resolved by a recent software update.

"They have already issued a software fix, and we are now installing," says ANA's Nishiwaki.

Ethiopian has already installed the new software, and it appears to work. "The spoiler was a problem. Nowadays, we don't have any spoiler problem," says chief pilot Hailemariam.

Other problems that once bedevilled the 787 also have been virtually eradicated three years after entry into service.

**"As we get fixes out,
new things come up as
components age and
the fleet grows"**

MIKE FLEMING

Vice-president for 787 support and services, Boeing

Hailemariam recalls early days when his pilots would push back from the gate, only to have to return after a spurious message appeared, warning of an inoperative control surface. Most of the time, there was no real issue, only a software bug.

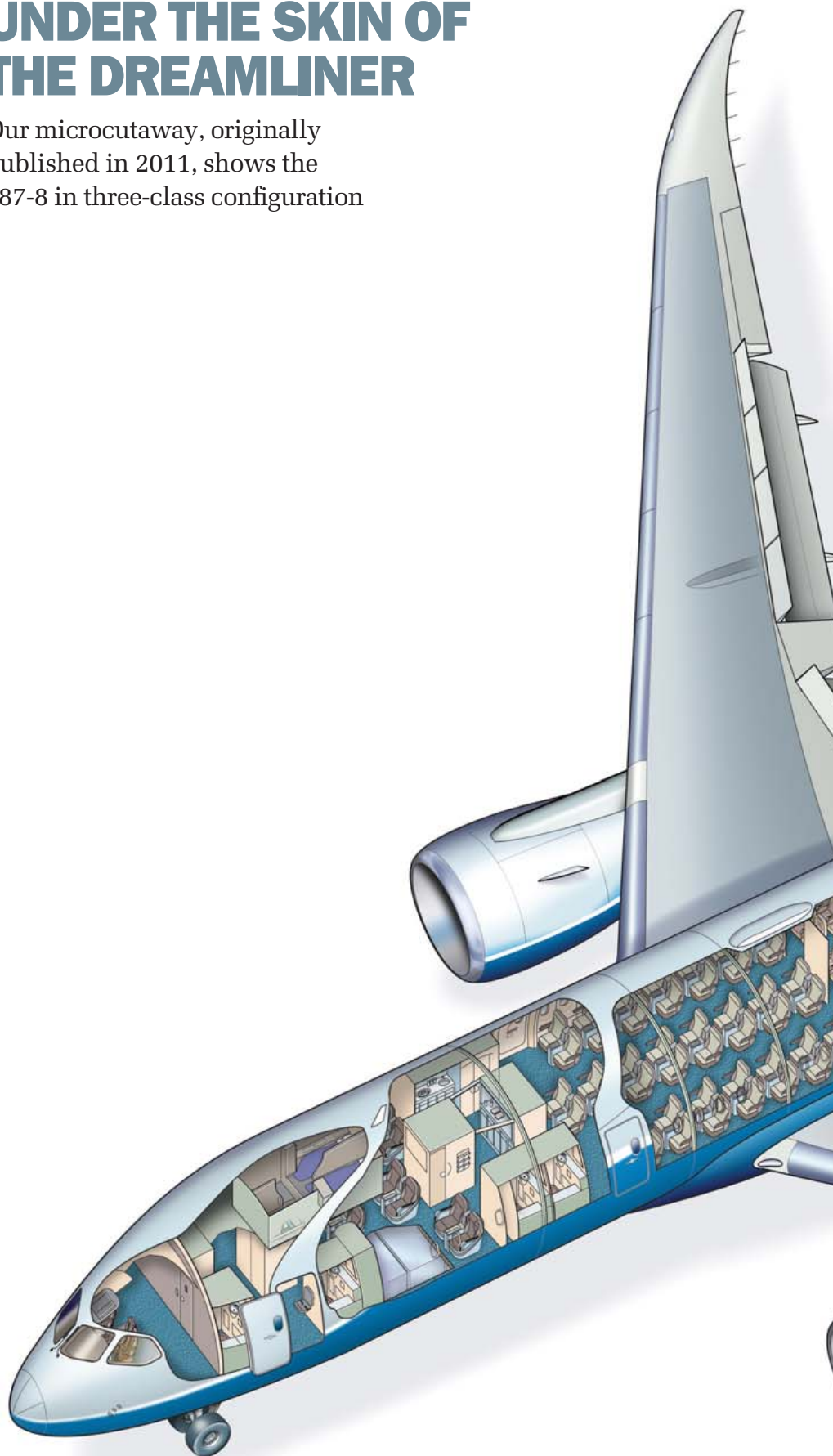
"We changed the flight-control software so many times, maybe three or four times," he recalls. "Right now I believe we don't have any such kind of a problem."

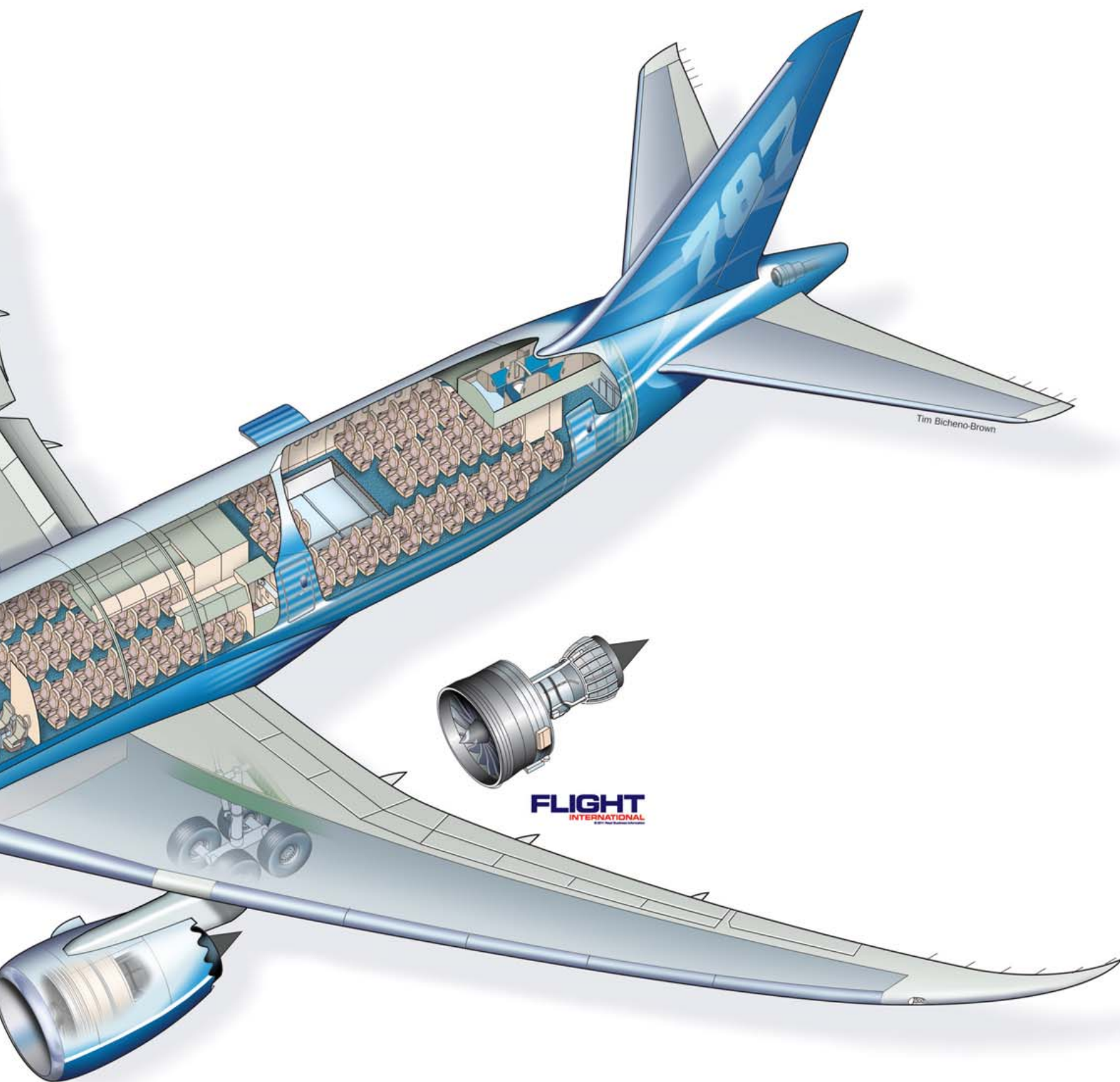
ANA's Nishiwaki remembers the software problem well. "It is easy to explain," he said. "Just before the flight, the flightcrew saw some flight-control message in the cockpit, which was a despatch message. In that case, even though they blocked out from the gate, they returned to fix it. But the corrective action is just to apply a ground test for the flight-control systems and clear – no component replacement [was necessary]."

A combination of hardware and software changes finally made the flight-control »

UNDER THE SKIN OF THE DREAMLINER

Our microcutaway, originally published in 2011, shows the 787-8 in three-class configuration





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PROPULSION

THE LAST BATTLE: R-R AND GE IN POWER STRUGGLE FOR ENGINE PERFECTION



Rolls-Royce's next move is to deliver the Trent 1000-TEN upgrade in mid-2016

IF ONE of today's market fashions becomes permanent, the Boeing 787 could be the last commercial widebody aircraft that offers buyers a choice of engines from competing suppliers – in this case the GE Aviation GEnx-1B or the Rolls-Royce Trent 1000.

This increasingly rare engine competition has delivered two propulsion systems with reliability levels well above the average at

the aircraft level. At the same time, it has so far failed to produce a turbofan engine designed by either competitor that meets Boeing's original promise of a 10% reduction in specific fuel consumption.

Additionally, competitive pressures have not provided airline customers with immunity from brief operational crises with both engines – in one case an operational restriction that

still continues. Both engines boast despatch reliability levels above 99%, the benchmark Boeing is still seeking to claim for the aircraft as a whole.

FLAWLESSLY

"The engines are operating flawlessly," says Zemene Nega, vice-president of maintenance, repair and overhaul for Ethiopian Airlines, a GEnx-1B customer. It has not always

been so. In July 2012, All Nippon Airways, a Trent 1000 customer, grounded five 787-8s after Boeing informed it of a potential problem in the gearbox. Crown gears had corroded faster than expected in endurance tests on the ground, causing damage to the engine. R-R traced the problem to a manufacturing process change by gearbox supplier Hamilton Sundstrand. It was corrected within weeks.

"Convection forces can carry ice crystals the size of a grain of flour to cruising altitudes above 30,000ft"

The GEnx-1B became the focus of the next engine crisis. A decision by GE Aviation to adopt a new lead-free coating on the fan mid-shaft backfired with explosive results. The coating caused the component to corrode faster in humid climates. In late July 2012, a GEnx-1B on board a newly assembled Air India 787-8 sustained a contained failure. GE reverted to a previous lead-based coating, and the problem disappeared.

A longer-term problem for GE Aviation is a relatively new phenomenon called ice-crystal icing. Liquid water is not present above about 22,000ft, so airframe icing is never a concern at cruise altitudes for a turbofan-powered widebody aircraft.

However, meteorologists have recently discovered the presence of ice crystals

» issues go away, Fleming says. But it also revealed what has become a familiar pattern. As soon as one major issue is retired, another glitch pops up that has been buried one level deeper in the system.

"As we get fixes out, new things come up as components age and the fleet grows," Fleming says. "There are systems that we've come out with a fix and experienced no further problems. There are other systems going through an iterative process to get them to mature."

The 787 was designed with a "moon-shot" approach to risk tolerance that is no longer welcome at corporate headquarters. It incorporated Boeing's first mostly composite commercial airframe, a bleedless systems architecture and a new generation of turbofan engine technology to save fuel. At the same time, Boeing attempted to reinvent how it designed and

Ethiopian Airlines has had a persistent problem with the 787's air compressors



at even higher altitudes, especially in tropic latitudes. In massive storm concentrations stretching 100km (62 miles) across, convection forces can carry ice crystals the size of a grain of flour to cruising altitudes above 30,000ft. The crystals bounce off an aircraft's skin, but can be ingested into an engine. It is believed that crystals land on a warm blade and begin to melt, which attracts other crystals to stick to the blade. Eventually, enough ice develops on the blade to cause damage downstream when it sheds.

PHENOMENON

The phenomenon is particularly acute on the GEnx engine. On its predecessor, the CF6, the ice build-up would most often shed as the aircraft descended. The GEnx experiences the ice shedding problem at cruise altitude, leading to in-flight engine shutdowns. As a result, the US Federal Aviation Administration issued an airworthiness directive last year requiring airlines to steer 787s at least 50 miles wide of major storm concentrations.



So far, customers have opted for the GEnx-1B by a nearly two-to-one margin

For some airlines, the restriction is an annoyance but not a network issue. Japan Air Lines, however, has pulled the 787 off three routes originating in Tokyo: Bangkok, Delhi and Singapore.

By contrast, the Trent 1000 engine faces no such operational restriction, says R-R project director Gary Moore. Fortuitously, the three-spool architecture of the Trent engine family hap-

"The engines are operating flawlessly"

ZEMENE NEGA

Vice-president of maintenance, repair and overhaul, Ethiopian Airlines

pens to be less prone to ice crystal build-up inside the core. The intermediate compressor section, which is absent in the GEnx design,

rotates at a higher speed, making it more difficult for dangerous quantities of ice to build up on the blades.

"We don't have this problem," Moore says. "It is just a very clear difference in the two engines."

Another clear difference between the engines is the order split. So far, 787 customers have chosen the GEnx-1B over the Trent 1000 by a nearly two-to-one margin, with 17% of

the order backlog still unspecified.

R-R places a couple of caveats on the GEnx-1B's strong start. First, not all airline decisions have been the result of a competition. When given the chance to compete, the Trent 1000 has claimed nearly half of the orders, Moore says. Moreover, the Trent 1000 is starting to gain some momentum. In the last 19 engine selections, the Trent 1000 has won orders 11 times, he says.

TARGET

R-R's next move is to deliver the Trent 1000-TEN upgrade in mid-2016. GE has acknowledged that the GEnx-1B misses Boeing's original specification for reducing specific fuel consumption by 1-2%. The Trent 1000-TEN – packed with technological improvements inherited from the Trent XWB – is still aimed at achieving the 787's original fuel-burn target.

"We're targeting the original spec that was put upon the airplane," Moore says. "You don't spend this level of investment to think we're not going to get there. We're going to get there." ■



built an aircraft, distributing design authority and production control on a global scale. The prolonged teething complaints and worse are part of the legacy of those decisions made years ago, but so is the aircraft's proven fuel efficiency. Despite the continued reliability headaches and development setbacks, 787 customers remain a remarkably loyal group. Asked if he thinks Ethiopian would buy the 787-8 if it had to make the decision again, Hailemariam did not hesitate: "Yes, because you get the performance, obviously. So it's just a matter of working through those teething issues."

The scale of the early challenges left its mark, but yet not a bitter taste for some.

"We were very harmed by this as an airline, but after more than one year of very successful operations I can only say it was worth waiting for, because the customer experienced the effi-

ciency of this aircraft," says LOT's Mikosz. As for Boeing, it still has to work through at least next year to meet customer reliability targets on the 787-8. Meanwhile, it has the 787-10, three versions of the 737 Max and two versions of the 777X already in development. None employ the moon-shot level of risk that Boeing accepted with the 787-8, but that does not mean there will not be challenges.

"I do think we will get better," says Fleming. "Is it ever going to be perfect? I'm a glass-half-empty guy. We shouldn't plan on it. We have to plan to be really busy and expect that there will be issues but work really hard to make sure that we don't." ■

Additional reporting by Greg Waldron in Tokyo, David Kaminski-Morrow in Palma de Mallorca, Oliver Clark in Warsaw and Firdaus Hashim in Singapore

From yuckspeak to tales of yore, send your offcuts to murdo.morrison@flightglobal.com

The camera that went into orbit

Apollo enthusiasts have had a chance to get their hands on an exclusive piece of 1960s space-race memorabilia. The Hasselblad camera and Zeiss lens taken into orbit by Wally Schirra on Mercury-Atlas 8 went up for auction last week.

A precursor to the Apollo missions, Schirra's 1962 flight saw him orbit the earth six times. A photography enthusiast, he had bought the camera in a Houston shop that year, and NASA tweaked it to install a 100-exposure film container, an aiming device and modifications to the camera surface.

It was after Schirra's MA-8 mission that NASA's "photographic identity began to take shape", says Bobby Livingston of RR Auction, which held the sale.

No kidding?

Thanks to Chris Scott for this charming photo (*right*).

As Chris explains: "A four-year-old explaining the merits of deployable flight recorders to a two-year-old. Either school is harder these days or technology hasn't advanced much!"

We are delighted to hear about anything that reduces the *Flight* reader demographic.

Taking a taxi

From the Only in Oz files: a 37-year-old man has been charged with taxiing a Beechcraft two-seat aircraft



Does this thing run on throat oil?



The Korean People's Air Force officers argued over who would ask the Supreme Leader to breathe in and buckle up



A is for Airbus, B is for Boeing...

(minus wings) through a busy town at two in the afternoon.

The accused had allegedly bought the aircraft from a private residence and was taking it home to the other side of Newman, but stopped at a pub on the way.

According to the Western



Launching NASA's photo identity

Australia police, the engine was working by means of an exposed fuel line connected to a jerry can inside the cabin. The accused, who does not have a pilot's licence, was due to appear in court on 18 November.

"On a scale from one to driving your plane to the pub, how much did you want a cold one?" asks one poster on the police's Facebook page, where the incident is reported.

"Probably only wanted a Red Bull," says another. "Apparently it gives you wings."

Steel the limelight

Although at the present time steel forms but a small

100 YEARS AGO

proportion of the material used in an aeroplane, there is little

doubt that in course of time it will be much more extensively employed – perhaps as tubing in some parts and as cast metal in others.

Gunning for a job

Applications are invited for duty as air-gunners. Applicants

75 YEARS AGO

must be between 28 and 35 years, have received a good education

and be used to handling men. A knowledge of machine-guns and experience of flying is an advantage, but not essential.

Mystery Liberators

When I was stationed at Leuchars in 1944, I saw a

50 YEARS AGO

detachment of Liberators. The aircraft carried few identification

marks, the rear turrets, bomb-bays and gun positions were removed and the American crews wore civilian clothes. Is it possible to unearth some background to these interesting operations?

Question time

Kenneth Merrick's book on Allied special duties operations

25 YEARS AGO

in the Second World War shows the Handley Page Halifax with normal

three-bladed propellers on its inboard Merlins, but four-bladed props outboard – not uncommon on 148 Sqn Halifaxes, he says – but why? Answers on a postcard with the usual fiver clipped to it, please.

100-YEAR ARCHIVE

Every issue of *Flight* from 1909 onwards can be viewed online at flightglobal.com/archive

EDITORIAL, ADVERTISING, PRODUCTION & READER CONTACTS

EDITORIAL +44 20 8652 3842

**Quadrant House, The Quadrant,
Sutton, Surrey, SM2 5AS, UK
flight.international@flightglobal.com**

Editor Murdo Morrison FRAeS
+44 20 8652 4395 murdo.morrison@flightglobal.com
**Head of Strategic Content/
Flight Daily News Editor** Dominic Perry
+44 20 8652 3206 dominic.perry@flightglobal.com
Managing Editor/Defence Editor Craig Hoyle
+44 20 8652 3834 craig.hoyle@flightglobal.com
Business Editor Dan Thisdell
+44 20 8652 4491 dan.thisdell@flightglobal.com
Operations/Safety Editor David Learmount
+44 20 8652 3845 david.learmount@flightglobal.com
Business & General Aviation Editor Kate Sarsfield
+44 20 8652 3885 kate.sarsfield@flightglobal.com
Aerospace and Defence Reporter Beth Stevenson
+44 20 8652 4382 beth.stevenson@flightglobal.com
Magazine Enquiries Dawn Hartwell
+44 20 8652 3315 dawn.hartwell@flightglobal.com

AIR TRANSPORT TEAM

Editor Airline Business Max Kingsley-Jones
+44 20 8652 3825
max.kingsley-jones@flightglobal.com
Editor Flightglobal Premium News Graham Dunn
+44 20 8652 4995 graham.dunn@flightglobal.com
Managing Editor Niall O'Keefe
+44 20 8652 4007 niall.okeefe@flightglobal.com
Air Transport Editor David Kaminski-Morrow
+44 20 8652 3909
david.kaminski-morrow@flightglobal.com
Air Transport/MRO Reporter Michael Gubisch
+44 20 8652 8747 michael.gubisch@flightglobal.com
Senior Reporter Oliver Clark
+44 20 8652 8534 oliver.clark@flightglobal.com

AMERICAS

Americas Managing Editor Stephen Trimble
+1 703 836 8052 stephen.trimble@flightglobal.com
Deputy Americas Editor - Air Transport Ghim-Lay Yeo
+1 703 836 9474 ghimlay.yeo@flightglobal.com
Air Transport Reporter Edward Russell
+1 703 836 1897 edward.russell@flightglobal.com
Air Transport Reporter Jon Hemmerdinger
+1 703 836 3084 jon.hemmerdinger@flightglobal.com
Aviation Reporter Dan Parsons
+1 703 836 7442 dan.parsons@flightglobal.com

ASIA/PACIFIC

Asia Editor Greg Waldron
+65 6780 4314 greg.waldron@flightglobal.com
Asia Air Transport Editor Mavis Toh
+65 6780 4309 mavis.toh@flightglobal.com
Asia Finance Editor Ellis Taylor
+65 6780 4307 ellis.taylor@flightglobal.com
Reporter Aaron Chong
+65 6780 4851 aaron.chong@flightglobal.com

EUROPE/MIDDLE EAST

Israel Correspondent Arie Egozi
Russia Correspondent Vladimir Karnozov

FLIGHTGLOBAL.COM

Editor Stuart Clarke
+44 20 8652 3835 stuart.clarke@flightglobal.com
Web co-ordinator Rebecca Springate
+44 20 8652 4641
rebecca.springate@flightglobal.com

EDITORIAL PRODUCTION

Head of Design & Production Alexis Rendell
Global Chief Copy Editor Lewis Harper
Chief Copy Editor, Europe Dan Bloch
Layout Copy Editors Andy Hemphill, Sophia Huang, Tim Norman, George Norton
Global Production Editor Louise Murrell
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DISPLAY ADVERTISEMENT SALES

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Sales Support Gillian Cumming
+44 20 8652 8837 gillian.cumming@rbi.co.uk

EUROPE

Sales Manager Shawn Buck
+44 20 8652 4998 shawn.buck@flightglobal.com
Key Account Manager Grace Hewitt
+44 20 8652 3469 grace.hewitt@flightglobal.com

NORTH & SOUTH AMERICA

Vice-President, North & South America Rob Hancock
+1 703 836 7444 robert.hancock@flightglobal.com
Regional Sales Director Warren McEwan
+1 703 836 3719 warren.mcewan@flightglobal.com
Sales Executive Kaye Woody
+1 703 836 7445 kaye.woody@flightglobal.com
Reed Business Information, 333 N. Fairfax Street,
Suite 301, Alexandria, VA 22314, USA

ITALY

Sales Manager Riccardo Laureri
+39 (02) 236 2500 media@laurerassociates.it
Laureri Associates SRL, Via Vallazze 43,
20131 Milano, Italy

ISRAEL

Sales Executive Asa Talbar +972 77 562 1900
Fax: +972 77 562 1903 talbar@talbar.co.il
Talbar Media, 41 HaGiva'a St, PO Box 3184, Givat
Ada 37808, Israel

ASIA/AUSTRALASIA

Sales Manager Michael Tang
+65 6780 4301 michael.tang@flightglobal.com
Fax: +65 6789 7575
1 Changi Business Park Crescent,
#06-01 Plaza 8 @ CBP, Singapore 486025

RUSSIA & CIS

Director Arkady Komarov
komarov@worldbusinessmedia.ru
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Korpus G, Office 807, Moscow 125190, Russia

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Recruitment Sales Executive Katie Mann
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Classified Sales Executive Daniel Brooker
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Key Account Manager - Asia Michael Tang
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ADVERTISEMENT PRODUCTION

Production Manager Sean Behan
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Production Manager Classified Alan Blagrove
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MARKETING

Marketing Director Justine Gillen
+44 20 8652 8031
justine.gillen@flightglobal.com

DATA TEAM

Head of Data Pete Webber
+44 20 8652 6715
peter.webber@flightglobal.com
Commercial Aviation Steven Phipps
+44 20 8652 6797
steven.phipps@flightglobal.com
Defence & GA John Maloney
+44 20 8652 6704
john.maloney@flightglobal.com

PUBLISHING MANAGEMENT

Head of Flightglobal Melanie Robson
Executive Director, Content Mark Pilling

READER SERVICES

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Jenny Smith
Flight International
Subscriptions, Reed Business Information,
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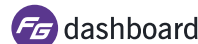
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Registered at the Post Office as a newspaper.
Published by Reed Business Information Ltd, Quadrant
House, The Quadrant, Sutton, Surrey SM2 5AS, UK.
Tel: +44 20 8652 3500.

Newtrade distributed by Marketforce (UK) Ltd, Blue Fin
Building, 110 Southwark Street, London SE1 0SU, UK.
Tel: +44 20 3148 3300.

Classified advertising prepress by CCM.
Printed in Great Britain by Polestar (Colchester) Ltd.

Flight International published weekly 49 issues per year.
Periodicals postage paid at Rahway, NJ. Postmaster send
changes to Reed Business Information, c/o Mercury
International Ltd, 365 Blair Road, Avenel, NJ 07001

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London, UK
marketforce.eu.com/events

1-2 December

Ascend Aviation 2020 Finance Forum
San Francisco, USA
monica.jani@rbi.co.uk

2-3 December

**Military Airlift: Current
missions and capability**
Rome, Italy
smi-online.co.uk

5 December

Aircraft Cabin Maintenance Conference
Heathrow, UK
aircraftcabinmaintenance.com

8-10 December

Middle East Business Aviation
Dubai, UAE
meba.aero

11-12 December

Safety in Air Traffic Control
London, UK
flightglobalevents.com/safetyATC2014

8-9 January 2015

International Space Conference
Amity University, Noida, India
aryavartspace.org/isc2015.html

8-10 February

Abu Dhabi Air Expo
Al Bateen Executive airport, UAE
abudhabiairexpo.com

18-22 February

Aero India
Air force station Yelahanka, Bengaluru
aeroindia.in

24 February - 1 March

Avalon Airshow
Geelong, Australia
airshow.com.au

17-20 March

**Asian Ground Handling
International Conference**
Conrad Hotel, Macao
groundhandling.com/ghicon/

25 March

European Corporate Aviation Summit
The Broadgate Tower, London
aeropodium.com/ecas.html

20-23 April

AeroDef Manufacturing
Hilton Anatole, Dallas
aerodefevent.com

4-7 May

AUVSI's Unmanned Systems
Atlanta, USA
auvshow.org/auvsi2015/

10-11 May

Aviation Africa
Dubai, UAE
aviationafrica.aero

19-21 May

EBACE
Geneva, Switzerland
ebace.aero/2015/

15-21 June

Paris Air Show
Le Bourget, Paris
siae.fr/EN



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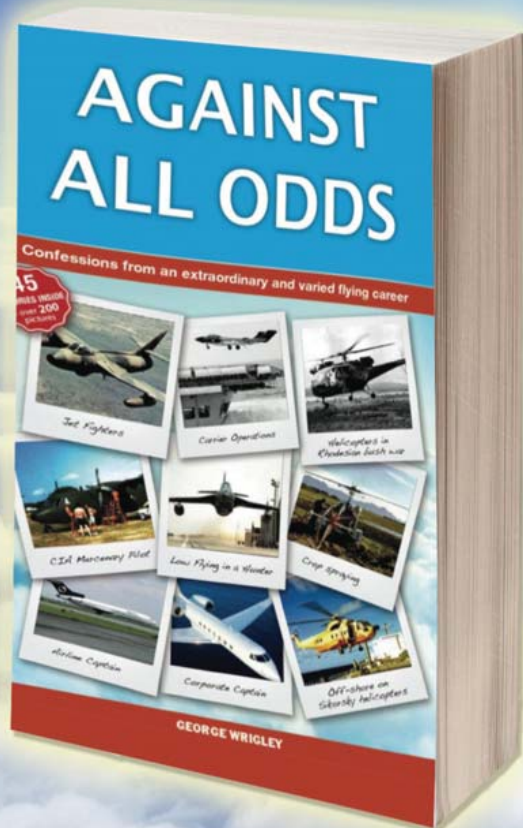
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Pilots and flying enthusiasts will enjoy this book of forty five stories by George Wrigley, taken from his extraordinary and varied forty year flying career. It is written in a racy style describing experiences, incidents, accidents and numerous narrow escapes as he progressed from his initial training in the Royal Rhodesian Air Force where he became a jet fighter pilot on Hunters, to flying Sea Vixens off HMS Victorious in the Royal Navy Fleet Air Arm. After returning to Rhodesia he flew Hunters, before becoming a Weapons and Flying Instructor. During the Rhodesian bush war, he flew Alouette helicopters on No 7 Helicopter Squadron.

After leaving the Air Force, he did stints crop spraying in both Rhodesia and the Western Cape in South Africa, flying a 47 Bell helicopter. He next qualified as a captain on Sikorsky helicopters doing off shore work to vessels rounding the Cape of Good Hope. He soon took the opportunity to spend an exciting year flying for the CIA from an island in the Caribbean dropping night supplies to the Contras in Nicaragua. When this contract ended, George returned to fly corporate jets for the President of Bophuthatswana and went on to become an Airline Captain in South Africa.

The stories are full of humour, romance and interesting characters he met along the way. It has good descriptions of hands on flying and also relates foolhardy escapades which he survived against all odds. It is packed with over 200 pictures to enjoy.

It is available via Kindle download or as two versions of hardcopies through Amazon at the following hyperlinks:
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- Possess a valid ICAO, FAA or JAA license (ATPL or CPL)
- Minimum 1500 hours total flight time with 1000 or above flight hours on multi-jet-airliner and/or multi-turbo-prop

For more details of the position, please visit Air Macau website Career Page: <http://www.airmacau.com.mo>

Interested and qualified candidates, please send your applications with a detailed CV to pilot@airmacau.com.mo

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The role will be based at the company headquarters at Gloucestershire Airport.

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State of Qatar Civil Aviation Authority are recruiting for the following two positions:

Aerodrome Inspector and Rescue and Fire Fighting Inspector

This is an opportunity to be involved in the regulatory oversight and further development of Hamad International Airport, Doha.

Applicants must be medically fit and have at least 5 years regulatory experience with a well-established Civil Aviation Authority, or as an Operations Director/Manager or Senior RFFS officer at a major International airport.

- Prospective candidates should have:
 - Experience with Aerodrome Operations or Rescue Fire Fighting Service operations at a major International airport
 - Regulatory and Auditing experience of major international aerodromes
 - Familiar with implementing ICAO Annex 14 Vol.I SARPs and the ICAO Aerodrome Certification Manual Doc. 9774, or EASA equivalents
 - Experience with the development and auditing of Aerodrome Manuals and Safety Management Systems
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Applicants with the required background and experience should send their CVs annotated on the envelope "Aerodrome Inspector" or "Rescue and Fire Fighting Inspector" to:

QCAA, Air Safety Department, PO Box 3000, Doha, State of Qatar
Email: safety.dept@caa.gov.qa



Career Opportunities

State of Qatar Civil Aviation Authority

Air Safety Department (Personnel Licensing division)

are recruiting for the following positions:

1-" Aircrew Licensing Inspector (Airplanes)"

Required Qualifications:

Holding of an ATPL (Airplanes).

Minimum of 5000 PIC flying hours on large airplanes eg:A320, B777, B787.

Proven experience in operational/training departments with a public air transport operator or with CAA, and including experience in oversight functions.

Adequate knowledge and familiarity with ICAO SARPs, JAA/EASA and national regulations.

Adequate experience in the aviation training field and the use of visual and audio training aids and flight simulators.

Able to create and write operating procedures and manual with minimal supervision

Highly literate in the use in the computer based word processor.

Preference will be given to applicants holding:

Current type rating on at least one of the Airbus / Boeing Airplane.

TRE/Examiner and/Instructor qualifications.

High degree of proficiency in technical English report writing.

2- "Aircrew Licensing Inspector (Helicopters)"

Required Qualifications:

Holder of ATPL (Helicopter).

Minimum of 5000 PIC flying hours on helicopters.

Proven experience in operational/training departments with a public air transport operator or with CAA, and including experience in oversight functions.

Adequate knowledge and familiarity with ICAO SARPs, JAA/EASA and national regulations.

Adequate experience in the aviation training field and the use of visual and audio training aids and flight simulators.

Able to create and write operating procedures and manual with minimal supervision

Highly literate in the use in the computer based word processor.

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WORK EXPERIENCE DENNIS MARTIN

Designs on the training market

After six years as a “man of mystery” flying around the world selling rotorcraft for Enstrom Helicopter, Dennis Martin now works as lead designer for the new TH180 trainer at the Michigan-based manufacturer

What attracted you to aviation?

I grew up on an airport. My dad had a small grass strip out in the country, and that's where I grew up, working on aircraft, sweeping hangars and mowing runways. Aircraft were always around. Aviation was always my first love, and I knew I wanted to work around aircraft. Fortunately, Enstrom happened to be close by, and I bugged them long enough and they happened to hire me.

You started in sales?

For six years I did international sales and marketing for Enstrom. So I flew around the world selling helicopters. How cool is that? I lived the “man of mystery” lifestyle. I've been on six continents. Along the way I've met the most incredible people and seen how aviation is done around the rest of the world and some of the challenges they go through to fly. Most of our sales have been international. Our turbine helicopter is a training aircraft. We've been selling a lot to foreign militaries. We sold 16 to the Royal Thai Army. We sold 30 to the Japanese defence force, and we just sold 16 to the Venezuelan air force. On the military side, we've been having great success with our turbine helicopters. They'll go from zero to a fully rated helicopter pilot in the Enstrom 480B.

Training is still the focus?

About half a year ago, we decided we wanted to invent a new model. They were looking for someone to head up the



Jeff Decker

Martin calls on his experience talking to customers in his latest role

programme, and I have a strong engineering background and a strong programme management background. But really, they said: “You've just spent six years talking to customers and hearing

“Designing a new aircraft is just a monumental challenge”

what they want. Go build it.” I got to take all those wishes and put them together. With the TH180 we're really going after the training market. Most of the aircraft that are being used are old designs that are expensive to operate, and a lot of them don't have good

safety records. This will be the safest aircraft on the market. It'll be less expensive to buy and less expensive to operate. Two seats; 210hp [157kW] engine; three-bladed, fully articulated rotary system; great tail rotor authority; fully governed engine: all the features you'd expect and more.

The TH180 is your main project?

Definitely. We're flying a proof of concept. We're prototyping a lot of new parts. It's hard enough installing a new radio or a new feature on to an existing aircraft. Designing a new aircraft is just a monumental challenge. We're shooting to have certification next year, and we actually have aircraft planned into the build schedule for the second half of next year.

What are the pros and cons of being a small manufacturer?

The downside is the resources. We don't have a department for this or a department for that. I wear a lot of hats. The upside is the flexibility and the responsiveness. We can make decisions really quickly. From an engineering standpoint it's exciting. I get to dabble in all these things and I don't get pigeonholed into one little product. At last count we're at 235 employees. We just doubled the size of the factory and we've added about 100 people in the last year. We're definitely a growing company right now.

What's the most difficult part of the job?

Dealing with all the regulations and certifications. We have a very good relationship with the [US Federal Aviation Administration] and that helps quite a bit. But the sheer volume of regulations and the challenge of certifying a new product, all the steps you have to go through, it's quite imposing. And on top of that, most of our sales are international, so once we get FAA certification we need to meet all of the foreign requirements, too. It's a huge challenge that is growing every day. ■



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— Dirk Reich, President and CEO, Cargolux



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